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COSTS OF PRODUCING BUTTERFAT.

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THE continuance of low prices for dairy-produce has placed the dairy-farmers of the Dominion in a precarious financial position, and has caused them to consider carefully the factors which determine their final costs. In this article certain of these factors are discussed, and some standards are suggested which may give farmers a reasonable basis of comparison with their own operations. The discussion is based on 1933–34 season's record of 550 dairy-farms situated in the North Island, the data having been originally collected and collated by the Department of Agriculture on behalf of the Royal Commission which recently submitted its report on the dairy industry. Full tabular details of these farm records are contained in the Commission's report. For the convenience of readers, descriptive details of the farms and their location are given in Table 1 (next page). It will be seen that the records are grouped in well-defined districts, with a collective grouping for the Auckland Province into North and South Auckland. The averages given for the 550 farms show that the herd performances and the number of cows milked per 100 acres are above the Dominion averages for the season, and the consequent average production of 117·73 lb. of butterfat per acre is comparable with the higher grade dairy-farms of the Dominion. The distribution of these farms and their efficiency of management as measured by performance makes the group a reasonable one on which to establish standards that are surpassed or are attainable, and which should be improved upon on all specialized dairy-farms.

PRODUCTION STANDARD.

The production standard should not be less than 120 lb. of butterfat per acre. To attain this approximately forty-eight cows averaging 250 lb. of butterfat must be milked per 100 acres of land farmed. If this production standard were attained the Dominion's 1933–34 season's output of 427,000,000 lb. of butterfat would be produced by milking 1,700,000 cows on 3,560,000 acres, instead of 1,816,000 cows on approximately 5,000,000 acres as was the case.

Table 1.—Analysis of 550 Dairy-farms showing Production, Costs, and Capital Position.

—		Northern North Auckland.	Eastern North Auckland.	Western North Auckland.	Southern North Auckland.	North Auckland.	Northern Waikato.	Mid-Waikato.	Eastern Waikato.	Tauranga.	Bay of Plenty.	South Auckland.	Taranaki.	Wanganui.	Manawatu.	Pumice Area.	Gisborne.	Wairarapa.	North Island.
Number of farms		25	26	30	34	115	30	42	31	11	30	144	86	38	73	29	31	34	550
Number of cows		1,315	1,489	1,746	1,792	6,342	1,439	2,670	2,533	918	2,374	9,934	5,138	1,687	3,754	1,765	1,353	1,663	31,636
Average butterfat per acre	lb.	74·93	90·43	107·30	98·42	92·98	131·49	140·54	165·91	118·49	145·10	143·69	121·05	109·06	133·94	85·35	110·61	104·78	117·73
Average butterfat per cow	lb.	211·3	223·0	225·5	239·8	226·0	272·0	266·1	296·6	231·5	259·9	263·2	278·3	256·6	271·2	221·5	227·6	245·2	254·0
Average cows per 100 acres	..	35·45	40·54	47·58	41·04	41·14	48·34	52·81	61·54	51·19	55·82	54·60	43·50	42·50	49·39	38·52	48·60	42·74	46·35
Average butterfat per labour unit	lb.	4,791	4,813	4,500	4,775	4,708	5,513	5,872	6,566	5,902	6,707	6,024	5,697	5,092	5,330	4,769	4,529	4,633	5,380
Average cows per labour unit	..	22·67	21·58	19·95	19·91	20·83	20·27	22·07	24·36	25·50	25·80	23·43	20·47	19·85	19·65	21·52	19·90	18·90	21·18
Average acres per male hand	acre	75·69	69·29	55·18	61·49	64·37	50·46	56·17	54·88	57·85	61·63	56·16	62·50	61·06	55·48	72·72	48·84	64·85	60·16
Average area per farm	acre	148·36	141·25	122·32	128·41	134·06	99·23	120·37	132·77	163·02	141·76	126·35	137·36	104·45	104·12	157·98	89·81	114·44	124·09
Average cows per farm	..	52·60	57·27	58·20	52·71	55·15	47·97	63·57	81·71	83·45	79·13	68·99	59·74	44·39	51·42	60·86	43·65	48·91	57·52
Average butterfat per farm	lb.	11,116	12,773	13,124	12,637	12,465	13,048	16,916	22,028	19,316	20,569	18,155	16,628	11,391	13,947	13,484	9,934	11,991	14,610
Average breeding-sows per farm	..	2·36	3·46	3·27	3·94	3·31	4·27	4·55	5·19	7·00	5·50	5·01	3·15	3·50	4·63	3·90	4·94	3·38	4·05
Average laying birds per farm	..	14·48	11·35	18·80	12·32	14·26	18·97	15·31	10·65	39·36	17·97	17·46	12·12	15·47	15·97	14·72	22·81	10·29	15·33
Average working-horses per farm	..	2·76	2·35	2·47	2·03	2·37	2·57	3·14	3·03	3·27	3·53	3·09	2·70	1·97	2·19	3·31	2·61	2·18	2·61
Average male workers per farm	..	1·96	2·04	2·22	2·09	2·08	1·97	2·14	2·42	2·82	2·30	2·25	2·20	1·71	1·88	2·17	1·84	1·77	2·06
Average female workers per farm	..	0·36	0·61	0·70	0·56	0·57	0·40	0·74	0·93	0·45	0·77	0·69	0·72	0·53	0·74	0·66	0·35	0·82	0·65
Average total labour per farm	..	2·32	2·65	2·92	2·65	2·65	2·37	2·88	3·35	3·27	3·07	2·94	2·92	2·24	2·62	2·83	2·19	2·59	2·71
Average breeding-sows per 100 cows	..	4·49	6·04	5·61	7·48	6·01	8·90	7·15	6·36	8·39	6·95	7·27	5·27	7·88	9·00	6·40	11·31	6·92	7·04
Average laying-birds per 100 cows	..	27·53	19·81	32·30	23·38	25·86	39·54	24·08	13·03	47·17	22·70	25·31	20·28	34·85	31·06	24·19	52·25	21·05	26·66
Average working-horses per 100 cows	..	5·25	4·10	4·24	3·85	4·30	5·35	4·94	3·71	3·92	4·47	4·48	4·52	4·45	4·26	5·44	5·99	4·45	4·54
Average male workers per 100 cows	..	3·73	3·56	3·81	3·96	3·78	4·10	3·37	2·96	3·38	2·91	3·26	3·68	3·85	3·65	3·57	4·21	3·61	3·59
Average female workers per 100 cows	..	0·68	1·07	1·20	1·06	1·02	0·83	1·16	1·15	0·54	0·97	1·01	1·21	1·19	1·44	1·08	0·81	1·68	1·13
Average total labour per 100 cows	..	4·41	4·63	5·01	5·02	4·80	4·93	4·53	4·11	3·92	3·88	4·27	4·89	5·04	5·09	4·65	5·02	5·29	4·72
Average capital value of implements per farm	£	95	157	136	118	127	139	163	169	238	165	166	211	150	152	166	100	156	157
Average capital value of farm buildings per farm	£	207	247	213	172	207	202	216	250	323	267	239	214	162	209	170	186	241	213
Average capital value of milking-plant per farm	£	225	205	192	226	212	188	195	190	198	215	197	180	189	178	215	188	204	195
Average capital value of implements per cow	£	1·807	2·744	2·342	2·247	2·299	2·891	2·573	2·065	2·852	2·089	2·399	3·523	3·369	2·966	2·724	2·285	3·181	2·735
Average capital value of farm buildings per cow	£	3·938	4·317	3·648	3·262	3·756	4·214	3·397	3·063	3·866	3·374	3·468	3·577	3·660	4·060	2·797	4·263	4·921	3·697
Average capital value of milking-plant per cow	£	4·266	3·571	3·304	4·282	3·842	3·921	3·066	2·329	2·380	2·711	2·854	3·018	4·252	3·456	3·527	4·304	4·181	3·394
Average Government capital value of land and improvements per farm	£	2,385	3,072	3,092	2,647	2,802	2,912	3,459	3,674	2,913	4,553	3,578	3,821	3,404	3,749	1,797	2,967	3,062	3,304
Average Government capital value of land and improvements per cow	£	45·35	53·65	53·13	50·22	50·81	60·70	54·41	44·97	34·91	57·54	51·86	63·95	76·68	72·91	29·53	67·99	62·61	57·44
Average Government capital value of land and improvements per acre	£	16·08	21·75	25·28	20·61	20·90	29·34	28·74	27·67	17·87	32·12	28·31	27·82	32·59	36·01	11·38	33·04	26·76	26·63
Average per cent. milking-plant repairs*	%	3·05	2·89	3·09	3·38	3·13	3·66	4·59	6·33	6·35	4·79	4·95	4·44	3·20	4·01	3·13	3·50	2·85	3·91
Average per cent. implement repairs*	%	5·15	3·44	3·31	3·49	3·70	3·09	3·81	4·54	5·76	5·34	4·37	3·85	3·18	4·78	4·89	4·28	4·13	4·13

* Per cent. repairs to capital value.

Cost Standards.

It is apparent that a reasonable production standard cannot be maintained unless money is spent on the upkeep of farms and herds and farm operators or owners are in receipt of at least a sustenance allowance for living purposes. Therefore these two contingencies must be provided for before any amount is made available to meet interest on capital employed. If they are not safeguarded first the potential production of farm units will be reduced or may disappear entirely. What is a reasonable allowance for working-expenses and for the reward of labour?

Working-expenses.

In this discussion working-expenses cover all items of cost other than labour reward of the owner or of permanent employees, and interest on owner's or borrowed capital. This broad allocation of working-expenses can be broken into subsections—namely, main working-costs, depreciation of plant, &c., sundry overhead expenses, and purchased feedstuffs. Working-expenses will be considered in these subsections, both on the basis of per cow and per pound of butterfat.

MAIN WORKING-COSTS.

This subsection includes costs of cultivation, fertilizers, casual labour, repairs to plant and machinery, power, materials, and sundry items. The district averages for this section range from approximately £2 4s. per cow, or 2d. per pound of butterfat, to £3 per cow, or slightly above 3d. per pound of butterfat. The average cost over the whole 550 farms is £2 12s. per cow, or 2½d. per pound of butterfat. The cost of fertilizers is the most important of this group, ranging as it does from about 3s. 6d. to £1 8s. 6d. per cow, with an average of over 19s. On a per pound of butterfat basis, fertilizers cost from 0·3d. to 1·5d., with an average of 0·9d. The cost of power is next in importance. Although the range of variation in costs between districts is slight, it averages about 8s. 6d. per cow, or 0·4d. per pound of butterfat. Of the average cost of £2 12s. per cow accounted for by this group of items, fertilizers represent 36·75 per cent. and power 16·5 per cent. These main working-costs amount on the average to 60·41 per cent. of the total working-expenses of the 550 farms.

DEPRECIATION OF PLANT, ETC.

When considering his working-costs the average farmer neglects to allow for the depreciation of implements, plant, and buildings. Even where correct accounts are kept and depreciation allowed for the money represented is not usually set aside for replacements, but is used in current upkeep or for personal expenditure. The fact remains that it should be allowed for, and, in the case of the farms under discussion, it amounted to 13s. 6d. per cow on the average, or approximately 0·64d. per pound of butterfat, or 15·61 per cent. of the total working-expenses.

SUNDRY OVERHEAD EXPENSES.

This subsection covers rates and taxes and sundry items such as telephone, subscriptions, herd-testing, motor registrations, &c. Rates

are an extremely variable cost, ranging from slightly over 3s. 6d. per cow, or 0·2d. per pound of butterfat, to almost 14s. 6d. per cow, or 0·76d. pence per pound of butterfat, according to the incidence of rates in the various districts. The average rate cost per cow over the whole group is 8s. 9d., or 0·42d. per pound of butterfat. The average cost for the whole group of items under sundry overhead expenses is 15s. 6d. per cow, or 0·735d. per pound of fat, and accounts for 17·97 per cent. of the total working-expenses.

STOCK-FEED PURCHASED.

A certain amount of stock-feed is purchased on all dairy-farms, particularly for pigs and calves and for poultry. This item has an average cost of 5s. 3d. per cow over the 550 farms, or 0·246d. per pound of butterfat, and accounts for 6·01 per cent. of the total working-expenses.

When all costs under the heading of "Working-expenses" are aggregated, it is found that the average costs for the various districts have a range of variation between districts of over £1 per cow, or from £3 16s. 3d. to £4 19s. 6d., with an average overall of £4 6s. 6d. On a per pound of butterfat basis, the variation between district averages is from 3·6d. to 4·7d. per pound, with an average overall of 4·1d. It can therefore be accepted that on well-managed farms producing 120 lb. of butterfat per acre the costs of production as enumerated under the foregoing headings is at least 4d. per pound of butterfat produced. We can now proceed to a discussion of the labour-reward position.

Labour Reward.

The cost of casual farm labour has been included in working-expenses, and we are now concerned only with the owner's or permanent labourer's reward. The question immediately arises as to the adequacy of any labour reward which can reasonably be allocated. The number of labour units permanently engaged on a farm must determine the minimum reward required for living purposes, but if labour is employed extravagantly the resultant labour cost per pound of butterfat will be greater than can be paid. It might reasonably be argued that the number of cows milked per labour unit should determine the level of labour reward. In actual practice farmers employ a minimum of paid labour and live on the smallest possible amount in an endeavour to meet their liabilities, but for the purpose of discussion it is necessary to assume a labour-reward standard which may be varied to suit requirements. Therefore a labour reward of £100 per annum per unit of male labour engaged on farms has been taken. This is probably more than the cost in wages and keep of the average employee, but where the owner only is concerned it may be inadequate to provide for family necessities. It is obvious that with a fixed labour-unit charge labour costs per pound of butterfat will vary according to the number of cows milked per labour unit and the production level of herds. In other words, a measure of management and labour efficiency is obtained. The effect, based on district averages, is to give a per pound cost range between 2·6d. and 4·4d., with a general average of 3·4d. per pound, which illustrates the scope for improvement in stock and in the

exploitation of labour. It can be accepted, however, that under the conditions prescribed in this analysis a labour cost of 3½d. per pound of butterfat should provide an annual payment of £100 per year per male unit of labour, if the size of the farm and herd is such that labour can be employed with a fair degree of efficiency.

We therefore arrive at the position where we can say that working-expenses and labour absorb 7½d. per pound of butterfat on well-managed farms producing 120 lb. of butterfat per acre. We must now consider the capital and interest position.

Interest on Capital.

There is no recent information available to show the actual interest burden of dairy-farmers. It is known that full liabilities cannot be met in a great percentage of cases. The Government valuation of these 550 farms is known, however, as is also the approximate replacement value of stock and plant. As Government valuation forms the basis for rates assessment, and to some degree for mortgages, a combination of valuation of land and improvements and of values of stock and plant can be accepted as a reasonable basis on which to discuss capitalization. It is well known that the purchase price paid for many farms has been well above Government valuation, which is in many cases exceeded by mortgages. The district group averages for Government valuation varies between £16 and £36 per acre, with an overall average of £26 12s., whilst stock and plant varies between £6 12s. and £9 per acre, giving a total capitalization basis varying between £22 and £44 per acre, or a general average of £34. This amount equals an annual charge of £1 14s. per acre on a 5 per cent. interest basis, or 3·4d. per pound of butterfat if 120 lb. per acre is produced. This added to working-expenses and labour reward would bring the total cost per pound of butterfat to 10·9d. If 20 per cent. of this assumed capitalization is farmers' equity, then the cost per pound would be reduced to 10·22d. at 5 per cent. If interest were reduced 1 per cent. the cost per pound of full capitalization would be 10·2d., or with 20 per cent. equity, 9·66d. per pound. What amount of interest can efficient farmers pay on reasonably good farms of economic size? Let us take the standard of 120 lb. of fat per acre and accept that 7½d. is a reasonable cost to cover working-expenses and labour. The prices realized to date for this season's dairy-produce suggest that an average pay-out of 8½d. in New Zealand currency may be expected. In addition to the return on butterfat, an amount equal on the average to 1d. per pound of butterfat may be obtained from pig products. The meat-marketing negotiations taking place in Great Britain indicate that bobby veal and boner cows cannot be relied upon to materially augment incomes from dairy-farms. The average gross returns per pound of butterfat produced should therefore approximate 9½d., or 2d. per pound above the costs of working and of labour, when the latter is assessed on the basis of £100 per annum labour reward per unit of male labour. A surplus of 2d. per pound devoted to interest would give £1 per acre on farms producing 120 lb. per acre. This amount when capitalized equals £20 per acre at 5 per cent., £25 per acre at 4 per cent., and £33 8s. (approximately) per acre at 3 per cent.

The Influence of Per Acre Production on Costs.

The discussion up to this stage has been based on district averages and on the average for the 550 farms which form the basis of the analysis. Standards have been set on an assumed "average farm," and this is a common practice when costs of production are under discussion. It must be stressed at this stage that it is impossible to apply such standards to dairy-farms, as no two units are exactly alike in composition and/or management. In the final analysis of the farmers' position, each case must be treated individually to ascertain working-expenses, labour efficiency, and reward, and the surplus available to meet the demands of capital. It is a fact, however, that certain principles apply generally, a knowledge of which enables a more rapid and comprehensive view to be taken. In this respect the influence of the level of production reached per acre is of the greatest importance as it is directly influenced by the inherent quality of the land, the type of stock carried, and the level of efficiency reached in general management. No matter what factors may be affecting production, the level reached has a direct bearing on costs per pound of butterfat and on the income available for distribution.

As indicated previously, the 550 farms under analysis are good farms for the districts concerned, and as a group can be accepted as above the Dominion average in per acre production. Nevertheless there is a wide range of variation within the group. The range of production, and the factors accompanying this spread is shown in Table No. 2.

Table No. 2.—Range of Butterfat Production per Acre.

Butterfat per Acre Range. (Pounds.)	Average Butterfat Per Acre. (Pounds.)	Cows milked per 100 Acres. (Number.)	Average Butterfat per Cow. (Pounds.)	Average Area of Farms. (Acres.)	Farms in each Group. (Number.)
Under 75	56·826	29·2	195	191·7	68
75–99·99	85·686	36·2	238	143·5	87
100–124·99	112·469	45·9	245	137·1	108
125–149·99	137·841	51·9	264	116·5	105
150–174·99	160·788	59·2	272	91·3	84
175–199·99	186·774	66·2	282	82·1	53
200–224·99	210·406	71·0	296	83·2	29
225–249·99	238·363	79·0	302	75·4	10
250 and over ..	281·535	86·9	324	85·6	6

The position indicated in this table shows the difficulty encountered in attempting to standardize farm data, particularly when it is remembered that the farms within these narrow production groups will show a degree of variation. It does, however, serve to show the factors accompanying or influencing production, and the rapidity with which the frequency of farms drop when the average production level is passed. This breakup into definite production groups can also be used to show the effect of production on costs and on the interest surplus. To illustrate the point, working-expenses are taken as the same group

of costs previously discussed, the same labour reward is used, and 9½d. per pound of butterfat is taken as the return from all sources. The results are shown in Table No. 3.

Table No. 3.—Costs and Interest Surplus per Pound of Butterfat according to Per Acre Butterfat Production Level.

Butterfat per Acre Range. (Pounds.)	Working-expenses per Pound of Butterfat. (Pence.)	Labour Cost per Pound of Butterfat. (Pence.)	Total Costs per Pound of Butterfat. (Pence.)	Interest Surplus per Acre. (Shillings.)
Under 75	5·014	4·439	9·453	..
75–99·99	4·335	3·841	8·176	9·5
100–124·99	4·171	3·516	7·687	17·0
125–149·99	4·058	3·147	7·205	26·3
150–174·99	3·806	3·164	6·970	33·9
175–199·99	3·813	3·041	6·854	41·2
200–224·99	3·640	2·885	6·525	52·2
225–249·99	3·438	2·671	6·109	67·3
250 and over	3·498	2·490	5·988	82·4

It will be seen that the interest surplus per acre increases rapidly under the influence of lowering costs per pound of butterfat, and an increasing production per acre. Whereas in the lowest production group costs equal income, the surplus rapidly rises until it reaches over £4 per acre, even under conditions of low prices. This increasing surplus is offset to some extent by a corresponding rise in Government valuation and in the replacement value of stock and plant. In this connection it is of interest to note that on these farms valuation shows a definite gradation upwards as production increases, but the rate of increase in valuation does not keep pace with the interest surplus. In other words, the Government valuation very justly does not fully capitalize potential production and efficiency in management. In Table 4 interest surplus is arranged against total capitalization (Government valuation plus value of stock and plant) and the capacity of the surplus to meet interest is shown at varying rates.

Table No. 4.—Interest Surplus according to Butterfat per Acre Range.

Butterfat per Acre Range. (Pounds.)	Interest Surplus per Acre. (Shillings.)	Total Capitalization per Acre. (£)	Interest Surplus. Capitalized at— 5%. (£)	4%. (£)	3%. (£)	Value of Stock and Plant per Acre. (£)
Under 75 ..	..	18·5	..	..	..	4·0
75–99·99 ..	9·5	27·7	9·5	11·9	15·8	5·9
100–124·99 ..	17·0	32·9	17·0	21·2	28·3	7·3
125–149·99 ..	26·3	38·0	26·3	32·9	43·8	8·4
150–174·99 ..	33·9	44·7	33·9	42·4	56·5	9·5
175–199·99 ..	41·2	52·1	41·2	51·5	68·7	10·9
200–224·99 ..	52·2	57·1	52·2	65·2	87·0	11·4
225–249·99 ..	67·3	58·0	67·3	84·1	112·2	12·4
250 and over ..	82·4	60·0	82·4	103·0	137·3	13·2

The facts disclosed in this table are really a summary of the position of the good dairying units of the industry to-day. Although total capitalization may not be an absolute measure of mortgages, there will be a close relationship between the two items. The capitalization of

interest surplus at varying rates shows that even at 3 per cent. it is not until we reach the 125 lb. to 150 lb. per acre group that the capital represented coincides with the total of Government valuation plus value of stock and plant. When studying the amount of capital per acre on which the varying interest-rates can be paid the value of stock and plant as shown in the table must be deducted to get the value of land and improvements represented, and it will be noted that the groups up to 100 lb. per acre provide a negligible surplus for interest on land mortgages.

The position disclosed can now be summarized—

(1) The group of farms forming the basis of this analysis are above the average for New Zealand in that the average production per acre is approximately 120 lb., whereas the average over all land devoted to dairying is probably about 90 lb. Therefore, if all farms could be considered, the percentage grouping in the lower-production classes would be greater than is indicated.

(2) The farms under consideration are economic units in that the number of cows milked allows of a reasonable utilization of labour. A large percentage of the dairy herds of the Dominion are small, and whereas in the group taken approximately thirty cows are milked per male unit of labour permanently employed there are many thousands of farms on which less than twenty cows are milked per male labour unit. Consequently, the cost of labour per pound of butterfat, even on a bare sustenance basis, is heavier where small herds are milked, and thus the interest surplus is affected. Coincident with high labour costs on such farms it is found that where herds are small, owing to the limited area of the farm, capitalization is heavy. In other words, small well-developed farms have a high capital value and, owing to the limited gross income even at maximum production, there is little or no surplus for interest, after working-expenses are met and the owner and family extract a bare living.

(3) The analysis again proves the constantly reiterated fact that low per acre production is associated with high production costs, and a low-interest-paying capacity. At a given price-level the number of farmers who are able to pay interest and the amount which can be paid depends on the numbers falling within certain production and size groups.

(4) The analysis demonstrates the necessity of considering any farm proposition individually when reviewing the ability of the farmer to meet his liabilities.

(5) The validity of the low interest surplus shown in the analysis depends on the degree of accuracy or reasonableness of the assumptions made. The costs covered under working-expenses cannot be disputed. If these are not maintained at a reasonable level the security represented in farms is undermined to the ultimate detriment of all concerned. It may be possible for dairymen to carry on with a lesser labour reward than the amount used in this discussion. If it is possible and the position is so controlled that a lesser amount is allowed, the interest surplus would be improved accordingly. The only other factor concerned is gross income per pound of butterfat sold. The final result for the current season can only be estimated at this juncture, but the basis for forming an estimate is available, and unless unforeseen circumstances arise there is no reason to be more optimistic than is denoted by the estimate of a final gross income of 9½d. per pound for butterfat, which includes average returns for pigs.

BOYS' AND GIRLS' AGRICULTURAL CLUBS.

RECORD OF ACTIVITIES IN WELLINGTON DISTRICT, 1933–34 SEASON.

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THE difficulties of the times have not passed this movement by, yet the season under review can again be recorded as another successful event in the history of the competitions, this being demonstrated by the increase in the number of entries received.

That the movement can still grow despite economic obstacles makes it one that must be regarded as successfully filling a place in the education and home life of the younger generation.

The following tables show the extent of the movement over the last three seasons. It will be noted that while the root-growing competitions have shown a small decrease, this has been offset by the expansion of the calf-rearing competition.

The completed entries in the crop competitions were :—

District.	Season.		
	1931–32.	1932–33.	1933–34.
North Taranaki	36	58	84
South Taranaki	217	197	192
Wanganui – Main Trunk ..	148	192	143
Manawatu	241	154	148
Southern Hawke's Bay ..	35	58	37
Wairarapa	28	..	..
Gisborne	..	..	9
Totals	705	659	613

The entries judged in the calf-club competitions were :—

District.	Season.		
	1931–32.	1932–33.	1933–34.
North Taranaki	288	309	350
South Taranaki	524	418	449
Wanganui – Main Trunk ..	190	192	190
Manawatu	227	231	227
Horowhenua	59	114	107
Southern Hawke's Bay ..	92	140	150
Wairarapa	101	203	251
Gisborne	..	..	36
Totals	1,481	1,607	1,760

Calf Clubs.

The activities of the calf-club movement have been established in Taranaki for a longer period than in any other part of the Wellington district at least, if not of the Dominion. That time has brought no lessening in the enthusiasm of earlier years can be gauged by a comparison of the entries brought forward for judging over the past nine seasons :—

Season.	North Taranaki.	South Taranaki.
1925–26	55	155
1926–27	115	242
1927–28	154	277
1928–29	215	311
1929–30	294	360
1930–31	250	403
1931–32	269	385
1932–33	306	418
1933–34	350	449

It might perhaps be assumed that the explanation of this steady advance of the movement lies in the fact that Taranaki is given mainly to the dairying industry. While perhaps this is partly correct, a perusal of the preceding table showing the growth of the movement in the Wellington district over the previous three seasons appears to indicate that, even though comparatively new in the remaining districts, the calf-club work is gaining general support. From the above two facts are apparent : the steady increase in the number of participants in the competitions is a proof that the principles of the movement are ones that interest and appeal to those eligible to compete, and the sustained growth is a practical demonstration of the interest and support given by parents and all interested in the welfare of the farming community.

While these two points are definite proof of general popularity, the question arises whether there is any definite indication that beneficial results are being gained through these competitions. The excellent score-cards handed in by many of the senior competitors in the judging competitions are in themselves sufficient evidence that the competitions are a successful medium of inculcating the knowledge of the essential points of good stock, which fact can have only one result —better stock and better farmers.

Crop Competitions.

NORTH TARANAKI.

As in previous years competitors were allowed the choice of a mangel carrot, or swede crop. To add further interest to the work, Prize-winner Yellow Globe mangels and Matchless White carrots were grown experimentally to compare the relative yields of 22 in. and 18 in. rows. In the case of swedes the comparison was between Superlative and disease-resisting Herning Swede. This trial is to be continued for a further season to verify the results obtained.

The entries in the competitions numbered 184, but out of this number only 84 plots reached the final judging. This heavy defection was caused principally by the incidence of heart rot in many of the mangel crops and by generally disappointing results in the swede crop—the roots made little development, the growth going into leafage and long neck.

The Trimble Shield for best club work was won by the Tikorangi School. Graham Caldwell, of Warea School, with a yield of 68 tons 10 cwt. per acre of Matchless White carrots, was not only the winner of this competition, but also next in merit to the winner of the Stuart Wilson Cup awarded for the Dominion champion field crop. The winning crop in the mangel competitions was grown by Walter Baker, Pukearuhe, the variety being Prizewinner Yellow Globe, with a yield of 142 tons 10 cwt. per acre.

SOUTH TARANAKI.

The fact that supplies of seed and manures could not be made a charge against the association caused considerable delay in deciding whether it was possible to run the competition, and it is pleasing to note that when this difficulty was given general publicity the following merchants showed in a very practical manner their interest and desire to co-operate in the continuance of the work by donating free of charge the necessary seed and fertilizer: Messrs. Hodder and Tolley, Cathie Dempster, Carter's Ltd., Webster's Ltd., Newton King, Ltd., New Zealand Loan and Mercantile, Farmers' Co-operative Society.

In the mangel-growing competition thirty-six plots were brought forward to the final judging with an average yield of 72 tons 3 cwt. per acre, which compares favourably with the record average of 73 tons 18 cwt. established in the previous season (1932–33). The winning crop was grown by Eva Gulliver, Whakamara, with a yield of 136 tons 17 cwt. per acre.

The carrot-growing competition attracted seventy entries, of which forty-eight reached the final judging. Opportunity was taken of conducting a variety trial with Webster's Matchless White and Carter's Orange Giant. Both varieties did well, with Matchless White giving the greater yield on almost every plot. The average yields were as follows: Matchless White, 51 tons 8 cwt. per acre; Carter's Orange Giant, 45 tons 9 cwt. per acre. The outstanding feature was the crop produced by Jean Williams, Meremere, which represented a yield of 100 tons 19 cwt. per acre.

WANGANUI.

As in previous years mangels, carrots, and swedes were grown, and it is noticeable that, parallel with the growth of the calf-rearing movement, there is a tendency for entries to fall away in these competitions. This reduction is perhaps due to the root-growing competitions losing some of their novelty, as they have now been in operation for the past fourteen years, whereas the calf clubs are a comparatively new and different sphere of activity.

Again this season all plots were located in the school grounds, thus placing all entrants on a uniform basis and successfully overcoming the difficulties arising from soil variation. The fact that 97 per cent. of the original entries reached the final judging is no doubt due to the greater measure of supervision that is possible under this method.

The extent to which the additional supervision has been reflected in the work of the competitors can be estimated by the fact that the Henry Lane Challenge Shield, awarded to the school gaining the highest aggregate in this and the Taranaki district, after remaining for a very long period in the Taranaki area, has now been won by the Alton School.

To all concerned in the administration of the movement it must be a source of satisfaction that their efforts have met with such a practical response from the competitors.

The number of plots entered was 147. The number of plots completed was 143.

The highest yield in tons per acre was: Mangels, 107; carrots, 69; swedes, 79.

The average yield in tons per acre was: Mangels, 43; carrots, 40; swedes, 47.

MANAWATU.

As in the previous year, the competition was confined to mangel production with two types being used for comparison purposes—namely, Red Intermediate and Prizewinner Yellow Globe—201 entries were received and 148 reached judging with an average yield of 59 tons 14 cwt. per acre, which has only once been exceeded.

The crop producing the heaviest yield was grown by E. Cask, Bainesse, and was equivalent to 115 tons 17 cwt. an acre. A feature of this crop was the number of solid roots it is possible to produce provided liberal initial seeding with a good strike, coupled with subsequent careful thinning is adopted. On the one chain selected for weighing, as being representative of the whole plot, 160 roots were counted, with an average weight of approximately 5 lb. a root.

SOUTHERN HAWKE'S BAY.

In this locality seasonal conditions were not favourable for mangel-growing, and this is reflected in the comparatively large number of the original entrants whose plots did not reach finality, the entries received being fifty-seven and the completed plots numbering thirty-seven. Three varieties grown were Red Intermediate, Prizewinner Yellow Globe, and Jersey Queen, which produced average yields of 66 tons 7 cwt., 63 tons 3 cwt., and 51 tons 17 cwt. per acre respectively. The winning crop was grown by Rodney Court, Woodlands Road, with an acre yield of 103 tons 10 cwt., the variety being Prizewinner Yellow Globe.

GISBORNE.

At present the competitions in this district are confined to the Tolaga Bay district, and, until the past season, have been controlled by officers of the District High School. Early last season representations were made for official recognition by this Department, and after certain negotiations, from which arose a general understanding of the rules and aims of the movement, the requested support was given.

On account of the initial arrangements not being finalized earlier in the year, the support of the Department of Agriculture was confined

to supplying the necessary stationery and some short lectures, the local officer being unable, on account of certification duties, to attend at the the final judgings.

The work of the club has been carried on under three main divisions: (*a*) Calf and lamb rearing competitions; (*b*) crop-growing competitions; (*c*) farm-instruction work for pupils of the secondary department of the district high school.

Calf and Lamb Rearing.—A field day was held at the school on 15th December, 1933, when thirty-six calves and twelve lambs were judged. For the initial effort this was very satisfactory. The high standard of the animals presented was remarked upon the by calf judge, Mr. Cooper, who said that he had never seen a better class of calves throughout New Zealand. The Poverty Bay A. and P. Association has inaugurated a class for yearling heifers shown in school parades, and Mr. Chamberlain, Secretary to this body, expressed the hope that the 1933 competitors from Tolaga Bay would be represented in this event in 1934.

Crop Competitions.—The crops were inspected by Mr. R. G. Lockhart, Instructor in Agriculture, Hawke's Bay Education Board, in February, and marked for choice of site, cultivation, and thinning. In his report to the Committee Mr. Lockhart remarked on the disappointing number of pupils who did not complete the course, the percentage being less than 25 per cent., and on the pleasing standard of work shown by those pupils who did.

The weights of the winning crops in both divisions were satisfactory, that of the leading crop of carrots being 79 tons 4 cwt. per acre and of mangels 93 tons 18 cwt.

In connection with both live-stock and crop competitions, thanks are due to the dairy company and a number of supporters who donated prizes and to the commercial firms who donated seeds and fertilizer.

Farm-instruction Work.—Much interesting and valuable work has been accomplished in farm instruction. A number of visits were paid to farms where work of a special nature was in progress, while a number of local farmers and Government officials visited the school and gave lectures or demonstrations. There were at least four visits or lectures per term.

MEAT-FREEZING INDUSTRY.

The quantities and values of the principal products for the years 1931–32, 1932–33, and 1933–34 are presented in the following table:—

Year.	Mutton.	Lamb.	Beef.	Preserved Meats.
	Quantities.			
	Carcasses.	Carcasses.	Cwt.	Cwt.
1931–32	2,802,818	8,395,661	545,957	34,233
1932–33	2,660,585	9,235,608	782,082	51,531
1933–34	1,995,435	8,582,957	981,757	46,324
	Value.			
	£	£	£	£
1931–32	1,574,798	5,775,708	546,252	103,100
1932–33	1,486,741	6,163,241	846,842	137,309
1933–34	1,461,056	7,095,262	924,758	127,658

—*Abstract of Statistics.*

HYDATID DISEASE.*

J. E. McIlwaine, Acting District Superintendent, Live-stock Division, Wellington.

The subject of hydatid disease in animals is a most important one for farmers and for all other rural workers in New Zealand. The need for information in regard to this disease in animals is important not only from a veterinary viewpoint, but more especially from the viewpoint that human beings are liable to become infected from a similar source to that of our domestic animals. It has been shown by Sir Louis Barnett, in the *New Zealand Medical Journal*, August, 1934, that hydatid disease in the human subject is increasing somewhat in New Zealand. In the *Journal* mentioned it is estimated that from a hundred to a hundred and fifty cases are occurring every year, with a mortality of about 15 per cent. Although only 15 per cent. of cases prove fatal, a number of other cases tend to recur from time to time and call for hospital and surgical treatment.

It is mainly because this disease in man and animals can be prevented that rural workers in New Zealand are asked to co-operate in the reduction of the number of the cases. The incidence of the disease can be reduced, provided an effort is made to do so. A few years ago Otago had the unenviable position of having the highest number of cases of hydatid disease in the human subject, whereas in more recent years that position has now been taken by Canterbury. The success in the reduction of the number of cases in Otago can be credited to those men in Dunedin and surrounding districts who have spent a good deal of time in teaching the people about this disease. New Zealand and Australia appear to be the main countries where this disease is so prevalent as to warrant the steps being taken to reduce its incidence. This feature of these two countries is apparently due to the extensive pastoral interests of both countries.

Hydatid disease in animals and man occurs as a result of the development in the body of what are termed hydatid cysts. These are bladder-like bodies which constitute the first stage in the development from the egg of a particular variety of tapeworm (technically known as *Taenia echinococcus*) which commonly infests the bowels of dogs. Among our domestic animals, cattle, sheep, and pigs commonly act as the intermediate hosts of this parasite, although man and even rabbits are on occasion also hosts.

What is a hydatid cyst? A hydatid cyst resembles in appearance a bladder of varying size distended with a watery-looking fluid. The cysts are more or less regularly rounded in shape and sometimes are present in large numbers in the one animal or person. The wall of the cyst is thin and if the cyst is suspended the wall is translucent. The cyst is often distended with fluid which is easily evacuated by puncture of the cyst wall. The cysts are most commonly found in the lungs and liver, but any organ of the body as well as other of the body tissues may be affected by them. The seriousness of the disease in the human subject is due to the fact that vital organs such as the lungs may be affected when surgical operations for their removal often prove very difficult. In the course of meat inspection which is carried out at the freezing-works and abattoirs throughout the Dominion, the cysts are often seen affecting the lungs and livers of cattle, sheep,

* Portion of a lecturette broadcast from Station 2YA.

and pigs. Cysts have even been seen in the muscular wall of the heart itself. In a few cases the lungs of the ox have been so completely affected with the cysts as to give the impression that the animal during life was affected with pneumonia or tuberculosis of the lungs. Any rural worker who is not familiar with the appearance of the cysts may have it demonstrated to him at almost any freezing-works during the busy killing season.

The presence of these cysts in the internal organs or tissues of cattle, sheep, and pigs does not constitute any danger to the health of human beings consuming their flesh. The connecting-link so far as the human being is concerned is between the infected dog and the human being. This will be made clear as we proceed with the life-history of the parasite which is responsible for the development of the cysts. By far the greater majority of food-animals in whose bodies hydatid cysts are present do not appear to suffer in health in consequence. Their bodies remain well nourished, and, so far as their flesh is concerned, they are perfectly healthy. The affected organs are, however, dealt with in the course of meat inspection for obvious reasons. On rare occasions an organ may be so grossly affected as to interfere with its natural function, when the affected animal may become weak and emaciated. In such cases, however, the inferior and innutritious nature of the flesh renders it unfit for human consumption, and the carcass of such an animal is dealt with accordingly. The real danger of the cysts becomes evident when these are eaten by a dog. The lining membrane of the cyst contains a number of smaller bladders, which in turn contain a number of small bodies. These in reality are the immature heads of the tapeworms. Each small body is capable of developing into the mature tapeworm when the uncooked cysts are eaten by the dog. The danger of propagating the tapeworms in the dogs lies in the feeding of dogs on uncooked offal containing hydatid cysts. Old dogs are more likely to harbour the parasites than younger dogs. Farmers' dogs which are fed on uncooked offal, or drovers' dogs which are not chained up on arrival at the freezing-works or abattoir, are liable to be more seriously affected than town dogs. The subject of hydatid disease is therefore of more direct interest to the rural worker amongst stock.

The particular tapeworm which is directly responsible for the dissemination of hydatid disease represents the smallest known species of parasite of its class. It is about $\frac{1}{4}$ in. in length when fully mature and is composed of three or four segments. The head becomes attached to the bowel wall of the dog, and the segments containing the ripe eggs are liberated and passed in the excrement of the dog. The mature detached segment, packed with eggs, may be deposited by the dog on pasture land where animals are grazing or near the edges of streams and watercourses, when the water-supply is contaminated. The contamination of green vegetables may be similarly brought about. Whenever cattle, sheep, or pigs or man swallow the eggs, either by ingestion of contaminated food or water, they run the risk of becoming subjects of hydatid disease. The eggs when swallowed and acted upon by the digestive juices liberate the immature worm. This bores its way through the bowel wall and is carried by the blood or lymph stream to the lungs or liver and there develops into the hydatid cyst. Infection may also directly occur from the dog owing to eggs being carried on the dog's coat, the dogs being fondled by their owners and their owners' children. The eggs are so small as not to be easily seen by the naked eye.

From what has already been said it will be apparent that precautions are more important so far as the human subject is concerned than is the case in the domestic animals. The important point in the prevention of the disease is in breaking the chain in the life-cycle of the tape-worm of the dog. This can be brought about in several ways. Firstly, there is the eradication of the tape-worms from the dogs by the regular dosing of dogs with suitable medicine. This can be effected by dosing the dogs every six months. The tape-worms can be eradicated by dosing the dogs with a preparation known as Tenaline. Freshly ground areca nut is often used in doses of 2 grains per pound body-weight of the dog to be treated. It is important to have the areca nut freshly ground. When this powder is given it is sometimes incorporated in butter, and the dog swallows it without the necessity of much dosing.

Arecoline hydrobromide, which contains the active principle of areca nut, is also used as an agent for the eradication of tape-worms from the dog. To eradicate the tape-worm it is necessary first to fast the dog for twenty-four hours. After treatment it is advisable to tie the dog up and treat all the contaminated excrement by burning, so as to destroy the worms and eggs.

Another break in the life-cycle of the parasite, the tape-worm, may be brought about by seeing that dogs do not feed on raw offal. If this rule were strictly observed on farms, sheep stations, in the vicinity of country slaughterhouses, abattoirs, and freezing-works, the dogs could not become infested with the tape-worm. If such offal is required for feeding dogs, it can be rendered harmless by boiling before use. The flesh of the animal is very rarely affected, but the offal constitutes a serious source of danger in this respect.

Still another break in the life-cycle of the parasite may be brought about by ensuring that the eggs passed by the dog are not consumed in the food or water used by the human subject. This is difficult to ensure in the case of herbivorous animals, but with care should be obtained in the case of the human subject. The fondling of dogs by human beings is not without risk, as the dog's coat is liable to contain eggs of the parasite. Infection from hand to mouth is obviously easy, and in children dirty hands may thus convey hydatid disease. The habit dogs have of licking their human companions' hands, face, or food utensils is, of course, dangerous. Dogs should not be allowed to eat off or lick plates or other dishes which are subsequently utilized for table or domestic purposes. It is possible for human beings to become infected by eating uncooked vegetables such as watercress, lettuce, celery, &c., which have been grown in an area exposed to canine contamination. Water from creeks or streams which is liable to be contaminated by dogs should not be used for drinking purposes unless previously boiled or efficiently filtered.

Flies may act as carriers, and food should always be protected from flies for this and other reasons.

It is to be remembered that a united effort on the part of dog-owners to reduce the incidence of hydatid disease in man will also considerably reduce it in animals, with, in consequence, less risk of the treated dog becoming reinfested. With this reduced incidence in stock the farmer will obtain a better return from his stock from the freezing companies. If the precautions which have been mentioned are taken over a number of years the number of cases of this disease in man could be materially reduced.

FARMERS' FIELD COMPETITIONS.

SUMMARY OF DOMINION RESULTS, SEASON 1933–34.

R. P. CONNELL, Fields Division, Department of Agriculture, Palmerston North.

THE number of entries judged in the Farmers' Field Competitions for the season 1933–34 exceeded by 62 the number for the previous season and thereby broke the previous record number of entries. The entries judged in the various districts for the past four seasons were :—

	1930–31.	1931–32.	1932–33.	1933–34.
Auckland	*	134	165	128
Wellington	560	807	875	966
Canterbury	*	*	46	64
Otago	*	*	30	20
	560	941	1,116	1,178

* Figures not available.

That the competitions continue to be given increasing support is gratifying because of the proven value of the information which well supported competitions are capable of yielding. Competitions normally enable instructive comparisons to be made between the results obtained from different practices in respect to such matters as manuring, cultivation, seed, varieties, and harvesting—matters in which there is much variation in the field. The reliability of the conclusions from such comparisons is governed to a large extent by the number of crops which are considered, and in some instances, because of the paucity of entrants, the full potential educational value of the competitions is not realized. Emphasis on the educational as distinct from the competitive side of the movement might assist participating farmers to persuade fellow-farmers to take part in the competitions and thereby increase their value to all concerned.

The main features of the competitions are summarized below.

MANGELS.

The number of mangel entries judged increased from 94 in 1932–33 to 118 in 1933–34.

The heaviest crop for the year was a phenomenal one of 170 tons 6 cwt. an acre, which is substantially heavier than any crop previously recorded in competition work. It was grown by Mr. H. T. Paul, Okato, in a holding paddock adjacent to the milking-shed, and hence greatly enriched by animal manure. The area was ploughed in mid-September and then given three double diskings, two harrowings, and a rolling. The variety Prizewinner Yellow Globe was sown on the 1st October

at the rate of 4 lb. an acre in ridges 17 in. apart. Special mangel manure was sown with the seed at the rate of 6 cwt. an acre. The seedlings were hoed twice before thinning and subsequently hand-weeded four times. Factors that contributed to the exceptionally heavy yield were (1) the accumulated animal manure, (2) the thorough preparatory working of the ground, and (3) the thorough management after sowing. In South Taranaki the heaviest crop was that of Mr. A. T. Burke, Lowgarth, which yielded at the rate of 105 tons an acre. In Wanganui district the heaviest crop was grown by Mr. T. Alexander, Maxwell, who obtained a yield of 110 tons 15 cwt. an acre by sowing 5 lb. an acre Prizewinner seed on the 15th October in drills 24 in. apart. The land which previously was occupied by swedes was ploughed in September, well cultivated, and drilled with 7 cwt. an acre of a mixture of superphosphate and blood-and-bone.

In Manawatu the heaviest crop, of 107 tons an acre, was grown by Mr. H. Hancock, Awahuri, who sowed 4½ lb. an acre of Red Intermediate on the 28th October in drills 26 in. apart. The land which was rich silt was ploughed in September, well cultivated, and received 3 cwt. an acre of blood-and-bone. Subsequent to sowing the crop was thoroughly cultivated, which contributed to the good yield. In Hawke's Bay the heaviest yield, one of 77 tons 11 cwt. an acre, was grown by Mr. G. Holden, Norsewood, in drills 18 in. apart.

In Pahiatua the winning crop of Mr. J. M. Bremner, Ballance, weighed 58 tons 15 cwt. an acre. Prizewinner Yellow Globe seed at the rate of 6 lb. an acre was sown on the 13th October, together with 7 cwt. an acre of mixed fertilizer on land which was ploughed early in September and subsequently well cultivated both before and after sowing. In Poverty Bay the heaviest crop, of 64 tons 12 cwt., was that of Mr. G. V. Smith.

In Auckland the heaviest crop, that of Mr. A. Woolsey, Patumahoe, yielded 40 tons 5 cwt. an acre. It followed swedes. The land was ploughed twice before planting, then ploughed at planting-time. The seedlings were transplanted into furrows as the land was ploughed and there was no after cultivation. The variety was Prizewinner Yellow Globe and the crop received 13 cwt. an acre of fertilizer consisting of 5 cwt. superphosphate, 5 cwt. Kainit, and 3 cwt. blood-and-bone.

In Canterbury the heaviest crop, of 121 tons an acre, was grown by Mr. A. Stalker, Rangiora, who skim-ploughed the land in May and in July ploughed it deeply with a swamp-plough. Farmyard manure at the rate of from 4 tons to 6 tons an acre was applied before ploughing deeply. It was well cultivated, and sown on the 27th September with 6 lb. an acre of Prizewinner Yellow Globe, together with 2 cwt. an acre of mangel manure.

Again Prizewinner Yellow Globe was prominent throughout in the prize list. In general the management of crops of those competitors who won prizes or secured heavy yields was characterized by (1) The provision of high fertility either by selecting naturally rich land or by liberally applying fertilizers; (2) thorough cultivation both before and after the sowing of the crop.

Swedes.

In the swede-growing competitions 172 crops were judged in comparison with 157 entries judged the previous year and 76 a year earlier. The heaviest crop in the competitions, that of Mr. H. E. Nowell, Cardiff, yielded 78 tons 5 cwt. an acre. On the 18th November 16 oz. an acre of Success swede, together with 3 cwt. an acre of special turnip manure was sown on land which was ploughed about the middle of October and subsequently double-disked seven times and harrowed three times. In South Taranaki the heaviest crop, of 74 tons 11 cwt., was grown by Mr. J. Kaiser, Kaponga.

In Manawatu the heaviest crop, of 70 tons 16 cwt. an acre, was grown by Mr. H. G. Hare, Arapata, who, on the 23rd November, sowed Masterpiece in 28 in. drills at the rate of 1 lb. an acre with a mixed manure consisting of 3 cwt. superphosphate, 2 cwt. ephos, 1 cwt. blood-and-bone an acre. In Hawke's Bay the winning crop, one of Superlative grown by Mr. G. Holden, Norsewood, yielded 64 tons an acre.

In the Wairarapa competition the winning crop, that of Mr. W. Olsen, Kohinui, was Superlative, sown at the rate of 1 lb. an acre in 28 in. drills, which yielded 78 tons an acre. It received 8 cwt. an acre of a mixture of equal amounts of superphosphate and blood-and-bone. The ground was ploughed out of pasture in early August, subsequently well cultivated, sown in early November, thinned, and twice intertilled in December.

In Auckland the heaviest crop, one of 53 tons an acre, was grown by Mr. K. Wright, Patumahoe, who sowed Superlative in 14 in. drills on the 30th November, together with 3 cwt. an acre of a proprietary turnip manure on land ploughed out of grass in September and subsequently well worked to a fine tilth.

In Canterbury the heaviest crop was one of 65 tons an acre of Superlative grown by Mr. A. Stalker, Rangiora, and in Southland the heaviest crop, of 58 tons 7 cwt., was grown by Mr. A. O. Fleming, Grove Bush, who sowed 11 oz. an acre of two varieties (Masterpiece and Elephant) about the 20th November on land which had been pre-limed and which at sowing received 3 cwt. of a mixture consisting of superphosphate 1 cwt., Island phosphate 1 cwt., carbonate of lime 1 cwt., and blood-and-bone ½ cwt.

The competitions usefully indicate that highly profitable crops of swedes are grown practically throughout the Dominion, and that, while good results are obtained under a wide variation in practice in respect to such matters as the amount of seed and manure, the distances between the drills, and the varieties used, significance must be attached to the frequency with which good yields are associated with thorough preparatory cultivation. Though there are apparently local preferences in respect to varieties, the number of crops considered in several of the districts is not great enough to provide a reliable indication as to whether such preferences are well-founded. A much favoured fertilizer treatment is the use of a dressing of 3 cwt. an acre in which phosphate is dominant.

Soft Turnips.

Only 17 crops of soft turnips were judged in the competitions. The heaviest crop recorded for the year was one of 60 tons 18 cwt., grown by Mr. A. D. Johnson, Okaiawa, Taranaki. In Auckland the crops judged were all in the Rotorua district. The heaviest, that of Mr. A. J. Gillanders, Reporoa, yielded 30 tons 16 cwt. an acre. In all Rotorua cases too much seed was sown, resulting in excessive growth of tops and crowded bulbs.

In Canterbury the heaviest crop, one of 40 tons an acre, was grown by Mr. F. W. Gartery, Springbank, who used land skim-ploughed out of grass in July and deeply ploughed in November, and who sowed 14 oz. an acre of Green Globe in 7 in. rows at the end of December. The turnips were cross-harrowed. Carbonate of lime and superphosphate in equal parts was used at the rate of 2 cwt. an acre.

Carrots.

In the competitions carrots were confined almost wholly to Taranaki, but the heaviest crop, one of 88 tons 8 cwt. an acre, was grown at Putorino in the Wanganui district by Mr. B. Newnham, who sowed on the 19th October 12 oz. of Matchless White an acre in 18 in. drills on land which was occupied by mangels the previous year.

In Taranaki Mr. J. Paulger grew the heaviest crop, of 74 tons 16 cwt. an acre, on land ploughed out of grass at the beginning of September. The land was worked very thoroughly, being disked twelve times and line-harrowed four times. Matchless White was sown at the rate of 8 oz. an acre in 11 in. drills on the 2nd November. The crop received the following fertilizer an acre: 2 cwt. of superphosphate, 1 cwt. of 30 per cent. potash salt, and 1 cwt. of blood-and-bone. In Hawke's Bay the winning crop, of 53 tons 1 cwt. an acre, was grown by Mr. P. G. Nickolaisen, Norsewood, who sowed Guerande in 14 in. rows.

Miscellaneous Crops.

Chou moellier crops featured in the competitions in Hawke's Bay and South Taranaki. In the former district Mr. G. Kells, Norsewood, grew an excellent crop of 46 tons 12 cwt. by sowing in 28 in. drills and thinning the plants to 15 in. apart. He ploughed early and applied 5 cwt. of ammoniated superphosphate prior to the sowing of the seed and a further 3 cwt. of superphosphate at the time of sowing. The crop was intertilled three times. The heaviest crop in South Taranaki was one of 39 tons 10 cwt., grown by Mr. J. Kaiser, Kaponga.

In various districts competitions were devoted to the following crops: Autumn fodder, maize, lucerne, red clover, potatoes, and green feed. While these competitions did not yield comparable data of general interest they indicate that the competition work can be adapted to the cropping problems of practically any district.

Economic Farm Competition.

A Southland competition, intrinsically of outstanding value, being based on economic considerations, calls for particular mention. The work of judging involved three visits to each of the competing farms,

which are divided into two classes—(*a*) over 250 acres, and (*b*) under 250 acres. The following tables contain the marks allotted to the farms gaining first and second places in each class :—

Farms over 250 Acres.

Points.	Max.	Competitors.	
		J. T. May, Thompson's Crossing.	A. O. Fleming, Grove Bush.
Steading, yards, &c.	50	43·5	37
Subdivision, fences, shelter, &c.	40	30·5	33·5
Pastures	145	116	116
Crops—cereal, fodder, stacks ..	100	65	87
Drainage, &c.	40	37	30
Implements and plant ..	25	23	20
Stock, carrying-capacity ..	175	149	135·5
Absence of weeds and rabbits..	25	18	22
Economics	400	344	284
Totals	1,000	826	765

Farms under 250 Acres.

Points.	Max.	Competitors.	
		R. H. Dickie, Tuturau.	R. S. Graham, Mataura Island.
Steading, yards, &c.	50	35·5	37·5
Subdivision, fences, shelter, &c.	40	33	38
Pastures	145	109	115
Crops—cereal, fodder, stacks ..	100	93	80
Drainage, &c.	40	33·5	29·5
Implements and plant ..	25	20	20
Stock, carrying-capacity ..	175	150	135
Absence of rabbits and weeds..	25	17	17
Economics	400	283	288
Totals	1,000	774	760

Ensilage and Hay.

The North Taranaki hay and ensilage competitions are described in the December, 1934, issue of the *Journal*. The principal results in other districts were :—

ENSILAGE.

Central Auckland.—Mr. A. Hill, Mauku.

Rotorua.—Mr. C. Musker, Tirau.

South Taranaki.—(*a*) Stack, Messrs. McGuinness Bros., Mangotoki ; (*b*) Pit, Mr. R. C. Treweek, Matapu.

Gisborne.—Messrs. J. Davenport and H. Davis equal.

East Coast.—Mr. L. S. Thomas.

Wairoa.—Mr. P. J. Brewster.

Pahiatua.—(*a*) Stack, Mr. T. G. Penfold, Konini ; (*b*) Pit, Mr. A. Booth, Kaitawa.

HAY.

Central Auckland.—Mr. E. W. Hill, Mauku.
Rotorua.—Mr. T. A. Turner, Rotorua.
South Taranaki.—(*a*) Meadow, Mr. H. Ward, Tokaora; (*b*) Lucerne, Mr. A. T. Burke, Lowgarth.
Westland.—Mr. C. Frankpit, Coal Creek.

Pasture Competitions.

The popular North Taranaki pasture competitions were discussed in the September, 1934, *Journal*. A pasture competition in the Central Auckland district was won by Mr. A. Woolsey, Patumahoe. Pasture competitions were also conducted in the Rotorua and Westland districts.

VERTICILLIUM-WILT OF POTATOES.

ITS APPEARANCE, CAUSE, AND EFFECT ON YIELD.

E. E. Chamberlain, Mycological Laboratory, Plant Research Station, Palmerston North.

Verticillium-wilt of potatoes causes considerable annual loss to growers in New Zealand. This disease has been recorded as occurring on potatoes throughout Europe and North America. It is known to have been prevalent in this Dominion for a number of years, but it was not recorded on potatoes until 1931. (Cunningham, 1931.)

Symptoms.

The first sympton of the disease is a rapid wilting of the leaves accompanied by the loss of their normal bright green colour. The foliage turns yellow and the plant dies (Fig. 1). Frequently the wilt occurs on only one of several stems of the plant, and, although remaining stems sometimes wilt later in the season, it is not uncommon for one or two to die, other portions of the plant remaining healthy (Fig. 2).

Under the conditions existing in New Zealand the disease usually appears at or just after flowering, and, since death rapidly follows wilting, infected plants die long before healthy ones reach maturity. In the early stages the stems of infected plants display no outward sign of the disease, but on cutting them transversely the vascular bundles are seen to be discoloured a light-brown. This discoloration may sometimes be traced down the stems to the tubers, where it appears as a vascular discoloration at the "heel" or "stem-end."*

Economic Importance.

Verticillium-wilt occurs in every potato-growing district in New Zealand. The two varieties Aucklander Tall-top and Aucklander Short-top appear to be particularly susceptible, and an infection of over 30 per cent. has been observed in a crop of the former.

* Many species of fungi other than that causing verticillium-wilt are capable of entering the tuber and bringing about a discoloration at the stem-end. As will be shown in a subsequent article, there is not necessarily any correlation between vascular discoloration of the tubers and verticillium-wilt of the plants.

The effect of the disease on yield has been determined by a yield trial conducted at this station. The seed tubers were taken from one line of potatoes, an attempt being made to obtain an infected and a healthy line by selecting tubers from wilt-infected and healthy plants.

FIG. 1. POTATO-PLANT INFECTED WITH VERTICILLIUM-WILT.
Healthy plant on right. [*Photo by H Drake.*

The plants were grown in replicate plots of ten plants per plot. The difference in wilt infection and crop yield may be seen from the following table :—

Table 1.—The Effect of Verticillium-wilt on Crop Yield.

	Number Setts.	Wilt Infection.		Yield.					
				In Tons per Acre.				Difference.	
		Per-centage.	Difference.	Table.	Seed.	Pig.	Total.	In Tons.	Per-centage.
Healthy line	100	13†	54	3·7	2·3	1·1	7·1	2·0	28
Infected line	100	67		2·9	1·4	0·8	5·1		

* The field count of wilt infection was checked by making fungous isolations from the stems, only those plants yielding *Verticillium albo-atrum* being classed as infected.

† The causal organism spreads from plant to plant through the soil, and in plants infected late in the season the fungus may reach the tubers without inducing any foliage symptoms. It seems probable that the parent setts of these plants became infected in this way.

For the difference of 54 per cent. wilt infection to cause a 28-per-cent. reduction in yield, the wilted plants must have yielded only half as much as the healthy.

Life History of the Causal Organism.

In other countries potato-wilt is caused by either *Verticillium albo-atrum* Reinke and Bert. or by *Fusarium* spp. (McKay, 1921; Goss,

FIG. 2. POTATO-PLANT SHOWING ONE STEM INFECTED WITH WILT WHILE THE REST OF THE PLANT REMAINS HEALTHY.

[Photo by H. Drake.

1923, 1924). It has been shown that in New Zealand the wilt is caused by *V. albo-atrum* (Chamberlain and Brien, 1933), and that in a number of lines of potatoes examined this was the only organism responsible for the disease (Chamberlain, 1935).

V. albo-atrum has been recorded as attacking a wide range of host plants (Rudolph, 1931), but in New Zealand it has been isolated from only potatoes and tomatoes (Chamberlain and Brien, 1933).

The life history of *V. albo-atrum* has been described in detail by Rudolph (1931). The fungus is a soil organism and is able to live on decaying organic matter. It enters the plants through the uninjured roots and grows along the vascular bundles into the stem, where,

FIG. 3. VERTICILLATE CONIDIOPHORES OF VERTICILLIUM ALBO-ATRUM × 270.
(*v*) Verticils; (*c*) Conidia. (Original.)

by blocking the vessels, it cuts off the supply of water to the leaves, thus bringing about wilting and death of the plant. The fungus penetrates to the tips of the branches and also travels along the underground portions of the stems and enters the tubers. Tubers thus infected if used as seed produce infected plants. The fungus may spread from infected to healthy plants through the soil.

During the course of attack the fungus is confined to the vascular bundles, but immediately the plant dies it spreads through all the tissues. Under favourable conditions it grows out to the surface of the dead plant, usually at the base of the stems, where it forms a white mycelium, from which arise the conidiophores or fruiting branches. Along the main axis of each conidiophore arise whorls of short branches or verticils which bear small spores (conidia) at their tips (Fig. 3). These spores may be carried by the wind to uninfected soil, where, under favourable conditions of humidity and temperature, they germinate and produce a mycelium. The spores do not survive winter conditions,

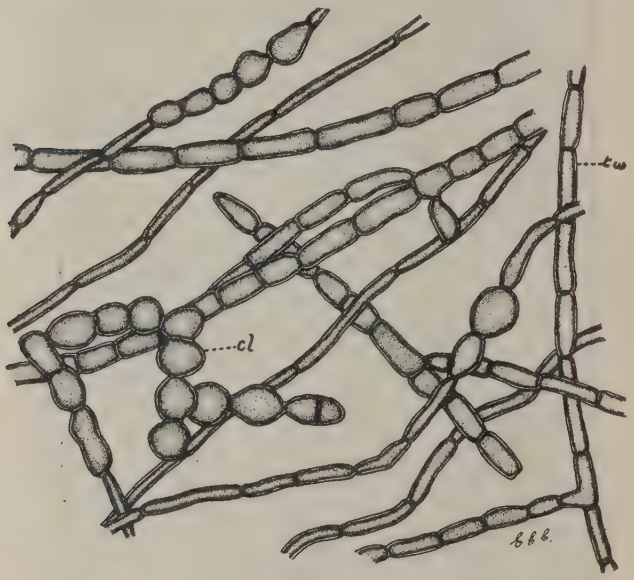

FIG. 4. RESTING MYCELIUM OF VERTICILLIUM ALBO-ATRUM × 825.
(*tw*) Thick-walled hyphæ; (*cl*) Chlamydospores. (Original.)

but when the fungus becomes established in the soil it forms a resting-stage. This consists of dark-brown, thick-walled hyphæ and chlamydospores (Fig. 4), and in this form the fungus is able to persist in the soil for several years.

It was pointed out by Pethybridge (1916) that not necessarily all the progeny of a wilted plant became infected. This was confirmed by the work of McKay (1921), and has also been demonstrated by experiments carried out at this station. Thus in Table 1 it may be seen that, although all tubers selected for the "infected line" were harvested from wilt-infected plants, only 67 per cent. of the plants developed wilt.

On the other hand, *V. albo-atrum* may be present in tubers from plants which have shown no sign of wilt during the season. Thus, in Table 1, of the one hundred tubers selected from apparently healthy plants thirteen produced plants which developed wilt.

The incompleteness of transmission of verticillium-wilt to the tubers and its presence in tubers from apparently healthy plants was further shown in an experiment in which stem-end isolations were made from tubers of healthy and infected plants. The results are given in Table 2.

Table 2.—Occurrence of Wilt-infected Tubers from Healthy and Infected Plants.

Apparently Healthy Plants.			Wilted Plants.		
Number of Plants.	Number of Tubers.	Number of Tubers infected.	Number of Plants.	Number of Tubers.	Number of Tubers infected.
100*	100	18	100*	100	51
1	8	2	1	10	1
1	8	2	1	9	6
1	8	0	1	7	5
1	6	2	1	7	3
1	6	0	1	6	3
1	5	0	1	5	3

* Isolations were made from one seed-size tuber selected from each plant.

SUMMARY.

(1) Potato-wilt in New Zealand is caused by *Verticillium albo-atrum* Reinke and Bert.

(2) It has been shown that the disease may cause a 50-per-cent. reduction in yield.

(3) All tubers of a wilt-infected plant do not necessarily become infected.

(4) The fungus may be present in tubers from plants showing no foliage symptoms of wilt.

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A trial relative to the improvement of grassland by surface sowing was laid down three years ago on a private farm of fairly heavy land near Palmerston North. The area was harrowed three times prior to sowing of the seed. A strip half a chain wide was pegged off as a control, and on this strip no seed was sown. The mixture sown was: 20 lb. certified rye-grass, 10 lb. cocksfoot, 3 lb. dogstail, 2 lb. white clover; total, 35 lb. an acre. During the first twelve months there was but little evidence to justify the added expense of the surface sowing, but during the last two years the contrast between the control strip and the remainder of the paddock has been very marked. The surface-sown area has a sward markedly superior to the control, and presents evidence of free establishment of perennial rye-grass, cocksfoot, and dogstail, while the control area is showing principally white-clover growth with a sprinkling of inferior annual plants.

FRUIT-TREE ROOTSTOCKS.

METHODS OF VEGETATIVE PROPAGATION.

C. E. WOODHEAD, Plant Research Station.

STOCKS for fruit-trees have been, and still are, largely raised from seed, and it cannot be denied that this method has its advantages in that the stocks are easily raised and little labour is required. A serious objection, however, to this procedure is that few species of fruit-trees are capable of producing seedling progeny true to type and of a uniform character, and consequently the material thus raised is always more or less variable. The influence of the stock on the general behaviour of the tree and the desirability of having pure races of stocks is now generally recognized, and methods of vegetative propagation are being investigated to secure greater uniformity in stock material.

Trials have been carried out during the past two years at the Plant Research Station, Palmerston North, to determine the best means of multiplying vegetatively various types of apple, pear, cherry, and plum rootstocks imported from the East Malling Research Station, England. The following is a description of two methods which have given satisfactory results.

STOOLS.

The young trees which are to form the "stools" are planted 2 ft. apart in rows, the distance between the rows being 3½ ft. A year later each plant is cut back to 2 in. above ground-level, this treatment resulting in the growth of a number of new shoots. When these have attained a height of about 4 in. soil is drawn round the base of the shoots in similar fashion to the "earthing-up" of a potato crop; additional soil is added as growth proceeds until each "stool" is moulded up to a height of from 6 in. to 8 in. No further attention is required until early winter, when the soil is removed and the rooted plants severed at the base from the parent stool. The stools are then left exposed until a new crop of shoots is produced the following spring.

This method of propagation has been applied at the Research Station to the following apple stocks, with very satisfactory results: East Malling, Nos. I, IX, XII, XIII, XV, and XVI.

With regard to the Northern Spy stock, covering the stools with about an inch of soil in early spring just as the buds are swelling is necessary to ensure satisfactory root-production. The reason for this procedure is explained below.

LAYERS.

One-year trees are planted in rows with the stems forming an angle of 30 degrees with the ground and lying along the rows, which are 4 ft. apart. The distance between individual plants in the row should be 3 ft. During the winter following that of planting the trees are lightly pruned and pegged down in a shallow trench so as to lie about 2 in. below ground-level (Fig. 1). When the buds commence to swell in spring the stems should be completely covered with about 1 in. of

FIG. 1. METHOD OF LAYERING A TREE.
[*Photo by H. Drake.*

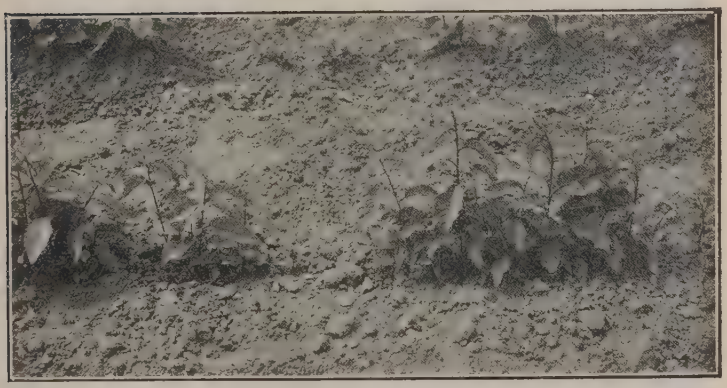

FIG. 2. NEW SHOOTS ARISING FROM LAYERED STEM OF CHERRY.
[*Photo by H. Drake.*

FIG. 3. ROOTED SHOOTS OF MAZZARD CHERRY.
[*Photo by H. Drake*

FIG. 4. ROOTED SHOOTS OF WILD PEAR.
[*Photo by H. Drake.*

soil. The success of this method depends on this soil-covering being applied at the time stated and to the correct depth. The new shoots have thus to force their way through this soil layer (Fig. 2), and the part of the shoot below ground remains white and sappy. It has been found that stems in this condition produce roots much more freely than when allowed to become hardened by exposure to the light. Moulding-up should keep pace with growth until the shoots have about 6 in. of soil round them, after which they can remain undisturbed for the rest of the growing-season.

Early in winter the soil is removed and the rooted plants severed from the parent stems, which are left exposed until the following spring. Shoots which have failed to root may be allowed to remain for subsequent "pegging down."

Figs. 3 and 4 show rooted plants of Mazzard Cherry and Wild Pear (*Pyrus communis*) respectively, after severing from the layered parent tree.

Pears, cherries, and plums, which do not root freely on "stools," can usually be induced to furnish well-rooted plants by adopting the layering method. At the Research Station this has been applied successfully to the following stocks:—

Pear: Selected seedings of the Wild Pear (*Pyrus communis*).

Cherry: Several types of the Mazzard Cherry (*Prunus avium*).

Plum: Brompton, Common Mussel, Pershore, Myrobalan B, and Black Damas C.

The two last-named plum stocks can, however, be propagated very readily and with less labour by means of hardwood cuttings.

In addition to the stocks above mentioned, the following commercial varieties of apple produced rooted plants when treated as layers: Cox's Orange, Delicious, Gravenstein, Jonathan, and Sturmer.

There are various factors affecting the degree of success attained in either of the two methods described. One of these is the age of the stools or layers. Rooting will become progressively better as the parent trees increase in age and the crop of shoots becomes more numerous and less coarse. The supply of moisture and the character of the soil also have a great influence on the results obtained, the ideal conditions for root-development being a sandy soil with an ample rainfall.

The fact that the estimated average production per cow for the 1933–34 season exceeded the highest average production previously recorded may be attributed partly to the weather conditions, which, although extremely variable, have, in general, been favourable for the production of butterfat—a well-distributed rainfall generally in the main districts compensated to a considerable extent for the smaller amount of top-dressing which was carried out. The relatively satisfactory average herd production may also be attributed partly to better provision of reserves of feed for use in those periods when the supply of feed directly available from grassland is unsuited to or less than the current needs of the stock—the increase in the area of grass and clover cut for hay and silage from 421,582 acres in 1931–32 to 517,469 acres in 1932–33 and substantial increases in the acreages of mangels and lucerne constitute evidence of this. Better farm-management in respect to other matters, such as improved pasture utilization and previous effort towards herd improvement, almost certainly also was operative.—*Report, Director-General of Agriculture.*

NOTES ON RECENTLY OBSERVED EXOTIC WEEDS.

H. H. ALLAN, Plant Research Station, Palmerston North.

9. An Asiatic Knotweed.

THE plant here discussed belongs to the genus *Polygonum*. This genus, closely related to the docks, is represented in New Zealand by one indigenous and several weedy introduced species. Well known among these are persicary or redshank (*P. Persicaria*), wireweed (*P. aviculare*), and bind weed (*P. Convolvulus*). Several other ornamental species are fairly commonly grown in New Zealand gardens, and tend to escape therefrom—*e.g.*, the prince's feather (*P. orientale*) and the snakeweed (*P. bistorta*). Buckwheat (*Fagopyrum esculentum*), occasionally grown in New Zealand, is also a closely-related species.

The plant under discussion, *P. cuspidatum*, is a native of Japan and China, and is sometimes grown in New Zealand gardens as an ornamental plant. It is a very vigorous grower, forming stout, bushy clumps, emerging from very thick, swollen basal stems. The aerial stems reach from 4 ft. to 8 ft. high, curving outwards, spotted or streaked with purple, and bearing luxuriant foliage. The leaves are broad, from 4 in. to 5 in. long, and pale-coloured below. They are rather abruptly narrowed to a short-pointed tip, and are square-cut or slightly heart-shaped at the base. The small white flowers are produced in small panicles in the axils of the upper leaves, the floral parts browning and broadening at fruiting-time. The above-ground parts die down in the winter, the plant persisting by its very stout underground stems. These tend to spread from the parent clump till large masses are formed.

It is a fairly useful plant for bold mass effects in large gardens, and for hiding rubbish-heaps or other unsightly spots. Unfortunately its vigorous root-system and spreading habit make it a nuisance when it escapes from cultivation.

My attention to its potential danger was drawn by Dr. W. Mackay, of Greymouth, where it encroaches on footpaths, and has so strongly established itself that eradication is proving difficult. Specimens have also been sent in from near New Plymouth, Inglewood, Masterton, and Hokitika. When sending specimens from Inglewood some years ago Mr. R. W. Brown wrote, "It has been in a paddock for a number of years and is spreading considerably." It has also been observed in waste places about Auckland, and taking charge of neglected gardens.

Also occasionally grown in gardens is "Sacaline" (*P. sachalinense*). This Asiatic species is still more vigorous, spreading rapidly by means of its underground shoots, and sending up tall stems, which may reach a height of 12 ft. The leaves are longer (up to 1 ft. or more) and narrower, more definitely heart-shaped at the base. The panicles are smaller and the flowers greenish. It has been grown for forage, but is not

worth consideration in New Zealand from that point of view, and has not great merit from the ornamental one. I have no record of it as a naturalized plant, but it certainly tends to escape from gardens, and if established would be a serious pest.

POLYGONUM CUSPIDATUM.

Small patches of these knotweeds could be carefully grubbed out, leaving no portion of the root-system, but larger areas would involve a great deal of work in controlling. Probably repeated applications of sodium chlorate would prove effective.

The Instructor in Agriculture at Ashburton reports that last year a mid-Canterbury farmer, being unable to dig potatoes because of continued wet conditions, had an iron band fitted to the digger and ran this under the sets in the rows of potatoes. The rows dried much more quickly, digging was easier, and the tubers came free from earth.

LOCALITY IN RELATION TO SEED-POTATO PRODUCTION.

EXPERIMENTS ON THE EFFECT OF PLACE OF GROWING ON YIELD AND INCIDENCE OF VIRUS IN POTATOES.

Fields Division.

THE importance of renewing periodically stocks of seed potatoes from selected localities such as Scotland or the North of Ireland has long been recognized by progressive potato-growers in Great Britain. Recent experiments(1) conducted in Wales have indicated that localities in North Wales can lay claim to the same advantages as the above-mentioned regions in the production of healthy seed and that the vigour of the seed from such suitable districts is bound up with relative freedom from virus diseases which in turn is largely dependent on the degree or the time of attacks of green aphis (*Myzus persicae*).

In order to investigate the suitability for the production of seed relatively free from virus of certain localities in the South Island of New Zealand two series of experiments have been conducted over the past few seasons and a third series of experiments is at present being carried out. The experiments are referred to in this report under the headings—(1) Southland-grown versus Ashburton-grown seed; (2) trials of locality of growing seed (Arran Chief); (3) trials of locality of growing seed (Dakota).

In each series seed, originally from the same line, was grown in various localities which could be described as either (*a*) commercial potato-growing districts or (*b*) districts which by virtue of their climate might be more suitable for the production of seed potatoes than others. The centres at which seed was grown are shown on the map (Fig. 1). The approximate height above sea-level of each centre is also given.

Seed from each locality was forwarded for inclusion in a central trial each year. The results of such trials to date are presented below.

SOUTHLAND-GROWN VERSUS ASHBURTON-GROWN SEED.

This series of experiments was carried out in co-operation with Mr. W. Dyett, West Plains, Invercargill, who grew a line of Arran Chief potatoes, supplied from the Ashburton Experimental Farm, for several years. Each season seed from Mr. Dyett's crop was returned to Ashburton and tried out against seed from the same line but grown continuously at Ashburton. Some of Mr. Dyett's seed was also grown at Ashburton in an "increase" block and seed from the latter included in trials during subsequent years.

The following results were secured in the yield trials carried out at Ashburton over a period of four years.

Season 1927–28.—The trial was planted on the 11th October, 1927. Two lots of seed were selected from each line from the 1926-27 crop; seed about and averaging 2½ oz. and seed about and averaging 1½ oz. in weight. There were eighteen replications of plots in which large seed were sown and sixteen replications of plots containing small seed.

(1) "Virus Diseases in relation to Commercial Seed Production." Whitehead, Currie, and Maldwyn Davies. *Ann. of App. Biology*, XIX, No. 4, Nov., 1932.

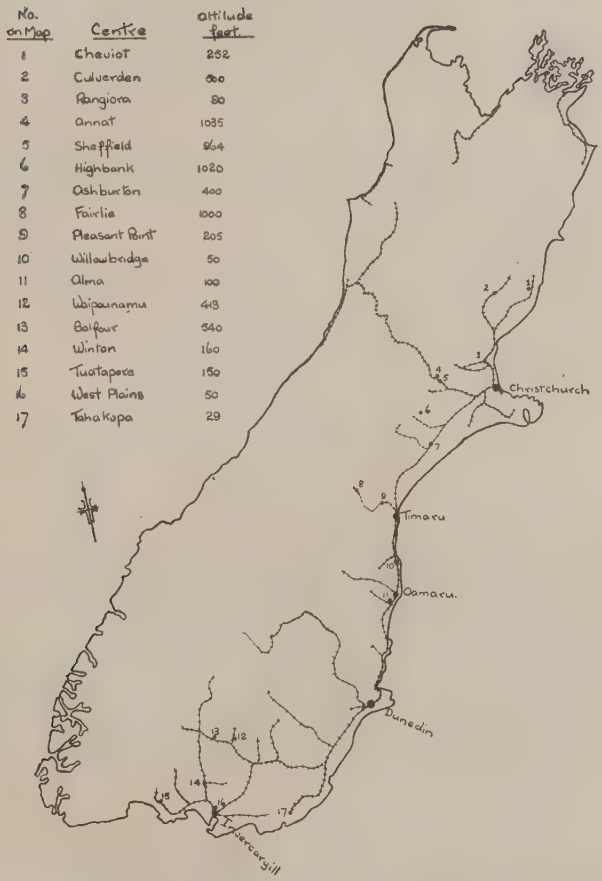

FIG. 1. MAP OF SOUTH ISLAND SHOWING GEOGRAPHICAL POSITION AND APPROXIMATE ALTITUDE OF EACH CENTRE AT WHICH SEED WAS GROWN FOR THE EXPERIMENTS.

Table 1.—Summary of Yields in 1927–28 Season.

History of Seed.	Yield in Tons per Acre.			
	Large Seed.		Small Seed.	
	Table.	Seed.	Table.	Seed.
Ashburton-grown	4·2	3·4	5·0	2·9
Southland-grown	4·1	3·4	5·0	2·7

Differences in yield were not significant. As Mr. Dyett did not keep seed from his 1927–28 season's crop, a further supply of Ashburton seed was forwarded and grown by him in 1927–28 for a trial in the 1928–29 season.

Season 1928–29.—The trial was sown on the 9th October, 1928, and contained thirty replications. In this and subsequent trials only one size of seed was used.

Table 2.—Summary of Yields in 1928–29 Season.

History of Seed.	Yield in Tons per Acre.	
	Table.	Seed.
Ashburton-grown ..	3·03	3·54
Southland-grown ..	4·30	4·09
Increase of Southland over Ashburton	1·27	0·55

The above increases were significant. The benefit derived from growing seed one season in Southland coincided with a heavy aphis invasion in Canterbury during the 1927–28 season.

Season 1929–30.—The lines of seed included in the trial were—(1) Ashburton seed (continuously grown at Ashburton for three seasons); (2) Ashburton seed grown in Southland for one year and then again grown at Ashburton for one year; (3) Ashburton seed grown in Southland for two years. The trial was sown on the 25th October, 1929. The plots were replicated forty-two times. Disease counts were taken during the growing-period.

Table 3.—Summary of Yields and Disease Counts in 1929–30 Season.

Seed as described above.	Incidence of Virus.	Yield in Tons per Acre.		Increase of (2) and (3) over (1) (Ashburton).	
		Table.	Seed.	Table.	Seed.
	Per Cent.				
(1)	63	2·3	2·2	..	..
(2)	42	2·9	2·6	0·6	0·4
(3)	39	3·3	2·5	1·0	0·3

The increases of lines (2) and (3) over line (1) were significant. The differences between (2) and (3) were not statistically significant.

Season 1930–31.—The experiment was sown on the 12th November, 1930, the following lines of seed being under trial: (1) Ashburton seed (continuously grown at Ashburton four seasons). (2) Seed from Ashburton grown for one season in Southland (1927–28) and for two seasons at Ashburton (1928–29 and 1929–30). (3) Seed from Ashburton grown for two seasons in Southland (1927–28 and 1928–29) and again at Ashburton for one season (1929–30). (4) Seed from Ashburton grown for three seasons in Southland (1927–28, 1928–29, and 1929–30). There were forty replications. Disease counts were taken on the 9th March, 1931.

Table 4.—Summary of Yields and Disease Counts in 1930–31 Season.

Seed as described above.	Incidence of Virus.	Yields in Tons per Acre.			Increase of (2), (3), and (4) from (1) (Ashburton).		
		Table.	Seed.	Total.	Table.	Seed.	Total.
	Per Cent.						
(1)	70·9	2·7	3·4	6·1	..	..	..
(2)	39·5	3·3	3·8	7·1	0·6	0·4	1·0
(3)	30·0	3·6	4·2	7·8	0·9	0·8	1·7
(4)	25·4	3·2	3·9	7·1	0·5	0·5	1·0

The yield of Ashburton (continuously grown) seed is significantly lower than the remainder. Line (3) (see grown two years in Southland and then one year at Ashburton) is significantly better than line (4) in all grades and significantly better than line (2) in seed and total potatoes.

It is difficult to understand the inferiority of line (4) (seed grown for three years in Southland) as compared with line (3) (seed once grown at Ashburton after two years in Southland). The disease counts do not indicate an appreciable difference in the amounts of virus, and, according to Mr. Cottier, Assistant in Entomology, aphid infestation, which is regarded as being the prime factor in the spread of this group of diseases, was generally worse in the Ashburton district than in Southland during the 1929–30 season.

The above-described series of experiments was not repeated after the 1930–31 season, since other trials were then established having the same objective and the Experimental Farm at Ashburton was being closed down.

Trials of Localities of growing Seed (Arran Chief).

A line of Arran Chief potatoes, which could be described as a medium commercial line moderately infected with virus, and grown at the Ashburton Experimental Farm in the 1928–29 season, was distributed amongst the undermentioned farmers, and crops were grown by them in the 1929–30, 1930–31, and 1931–32 seasons: B. Richardson, Willowbridge, Canterbury; T. Hanna, Rangiora, Canterbury; J. Cooper, Alma, North Otago; A. McGiffert, Cheviot, Canterbury; R. Wilson, Highbank, Canterbury; A. F. Campbell, Fairlie, Canterbury; J. Cowie, Balfour, South Otago; L. Wright, Annat, Canterbury; Experimental Farm, Winton, Southland.

A portion of the same line was retained at Ashburton and grown there during the first two seasons mentioned above. In the 1931–32 season owing to the closing-down of the Ashburton Experimental Farm seed of the original line was grown on the farm of the Rangiora High School.

At the close of each season a portion of the seed grown by each co-operating farmer was collected and forwarded for inclusion in a central trial, where the subsequent crop was compared with that from the original line in regard to its yield and amount of virus. The central trials were carried out at Ashburton in 1930–31 and at Rangiora High School in seasons 1931–32 and 1932–33.

Layout and Details of Central Yield Trials.

All the lines of seed were grown under the same conditions as regards manuring and cultivation and an equal number of "sets" was planted in each plot. Plots were replicated forty times, and in seasons 1930–31 and 1931 32 the control line (Ashburton) occupied every third plot so that yields could be examined by "students'" method.

In the 1932–33 season forty replications of plots were set out on the randomized-block method and results were analysed statistically by the analysis of variance method of Fisher and Wishart.

During the growing-season counts were taken on the incidence of virus diseases in the various plots.

Season 1930–31, at Ashburton.—The experiment was laid down on the 11th November, 1930. Disease counts were taken on the 26th February, 1931. The plots were dug and weighed on the 4th June, 1931.

Table 5.—Summary of Disease Counts, Yield of Control, and Difference of each line from Control.

Seed from Crop grown in 1929–30 at—	Incidence of Virus.	Yield of Control and Difference in Yield from Control of each Line in Tons per Acre.		
		Table.	Seed.	Total.
	Per Cent.			
Control (Ashburton) ..	22·4	2·1	1·2	3·3
(1) Willowbridge ..	24·7	−0·2	−0·1	−0·3
(2) Rangiora	21·0	−0·3	0·0	−0·3
(3) Alma	24·9	**−0·3**	−0·1	**−0·4**
(4) Cheviot	23·8	0·0	0·0	0·0
(5) Highbank	23·5	−0·2	0·0	−0·2
(6) Fairlie	21·8	−0·1	0·0	−0·2
(7) Balfour	23·5	**+0·3**	−0·2	+0·1
(8) Annat	21·3	+0·3	−0·2	+0·1
(9) Winton	24·4	−0·3	0·0	−0·3

Differences printed in heavy type are statistically significant.

Table 5 shows that there were no appreciable differences in the incidence of virus in the crop from each line of seed. The seed from Alma gave a significantly lower yield than control, and that from Balfour was significantly higher than control in table grade, but differences were only small. The crop was a very poor one owing to late planting and dry weather.

Mr. Cottier, Assistant in Entomology, who inspected the crops grown for seed in 1929, commented on the yields as follows: "In the table of yields the only significant lowering in yield is shown from the one at Alma. In records of numbers of insects on these crops in December, 1929, the aphis *Myzus persicae* was considerably more abundant on this crop than on any of the others. In my glass-house experiments it has been shown that of the characteristic insects of the potato foliage this one is the main insect carrier of leaf-roll."

Season 1931-32, at Rangiora High School. The experiment was sown on the 2nd November, 1931. Disease counts were taken on the 6th February, 1932. The plots were dug and weighed on the 31st May, 1932.

Table 6.—Summary of Disease Counts, Yield of Control, and Difference of each Line from Control.

Seed from Crop grown in 1930-31 at—	Incidence of Virus.	Yield of Control and Difference in Yield from Control of each Line in Tons per Acre.		
		Table.	Seed.	Total.
	Per Cent.			
Control (Ashburton) ..	38·8	0·7	4·5	5·2
(1) Willowbridge ..	41·2	+0·1	−0·1	0·0
(2) Rangiora	45·8	**+0·2**	−0·3	−0·1
(3) Alma	46·5	+0·1	−0·3	−0·2
(4) Cheviot	45·7	**+0·3**	−0·1	+0·2
(5) Highbank	24·6	**+0·3**	**+0·5**	**+0·8**
(6) Fairlie	23·6	**+0·2**	**+0·7**	**+0·9**
(7) Balfour	23·7	+0·2	+0·3	**+0·5**
(8) Annat	21·0	**+0·3**	**+0·6**	**+0·9**
(9) Winton	17·6	**+0·3**	**+1·4**	**+1·7**

Differences printed in heavy type are statistically significant.

As indicated in Table 6, owing to extremely dry conditions in late summer, the crop was poor and gave rise to a large proportion of seed-sized tubers. In the case of control and lines (1), (2), (3), and (4) the incidence of virus was greater than on the previous season (see Table 5). In each of lines (5), (6), (7), and (8) the percentage of virus was appreciably lower than the remainder, and was approximately the same as in the previous season. The yields of these relatively low virus-infected lines were in all cases significantly higher than control (Ashburton) in total potatoes, and with the exception of line (7) (Balfour) were also significantly better than control in table and seed grades.

Season 1932-33.—In the 1932-33 season's yield trial, which was again carried out at Rangiora High School, seed grown at Highbank and Fairlie was not available for inclusion. The seed from Willowbridge, although grown in the trial, was found to be so contaminated with rogues of Northern Star that results from this line have not been included in the following table. The trial was sown on the 1st November, 1932. Disease counts were taken on the 8th February, 1933. The plots were dug and weighed on the 12th May, 1933.

Table 7.—Summary of Disease Counts, Yield of Control, and Differences of each Line from Control.

Seed from Crop grown in 1931–32 at—	Incidence of Virus.	Yield of Control and Difference in Yield from Control of each Line in Tons per Acre.		
		Table.	Seed.	Total.
	Per Cent.			
(1) Control*	31·2	1·3	5·0	6·3
(2) Rangiora	62·6	**−0·5**	**−1·4**	**−1·9**
(3) Alma	59·4	**−0·5**	**−0·8**	**−1·3**
(4) Cheviot	57·9	**−0·4**	**−1·3**	**−1·7**
(7) Balfour	27·3	**−0·3**	+0·3	0·0
(8) Annat	14·6	−0·1	**+0·5**	+0·4
(9) Winton	17·6	+0·3	+0·2	+0·5

* Seed grown at Rangiora High School as Ashburton Experimental Farm had been closed down.

The season was again very dry and only low yields as indicated in Table 7 were obtained from the trial. Apart from the unfavourable weather conditions, however, it is evident that the cropping-power of the line of seed used was very poor, since a block of Dakotas grown on the same farm yielded 6 tons table and 4 tons seed potatoes per acre.

Lines (2), (3), and (4) showed a further increase in the percentage of virus over the previous season, and were almost twice as badly infected as the control. The yields of these were also significantly lower than control in all grades. Line (7) showed a similarity to control both in virus-infection and yield, and, although the latter was significantly higher in table, line (7) was heavier in the seed grade by a similar amount, although this difference was not significant. Lines (8) and (9) were appreciably lower in the percentages of virus than control, and the former gave a significant increase in seed grade over control.

It is of interest to note that the control, which was grown from seed raised at Rangiora High School, showed a lessened incidence of virus than the same line in the previous year, which was grown from seed raised at the Ashburton Experimental Farm. While the difference between the two seasons' results as regards virus is only small and could be entirely due to seasonal fluctuations it will be observed that line (2), grown from seed raised within a mile or so of the High School, shows a definite deterioration when the virus infection in 1932–33 is compared with that of 1931–32. It may be asked, Why should one line improve in this respect while another grown in the same district deteriorates? The reason is probably due to the difference in yield of the parent crops grown in the 1931–32 season. The crop grown at the Rangiora High School (0·7 tons table, 4·5 tons seed) contained a very high proportion of seed to table potatoes, whereas the crop grown on the farm of Mr. T. Hanna, Rangiora, yielded 5·3 tons table and 1·7 tons seed potatoes. It is very likely that much of the seed from the latter has been the progeny of virus-infected plants whereas the seed from the Rangiora High School crop would be largely from normal plants, because dry conditions following late planting of the crop

would prevent many of the virus-infected plants from forming even seed-sized tubers. The seed used would then be drawn largely from healthy plants.

Records kept of yields of all the crops from which seed has been taken in this series of trials do not suggest any correlation between yield of a crop or proportion of seed grade to table grade and performance of the seed from that crop, but the explanation given above is feasible when the abnormal nature of the 1931 32 season's crops at Rangiora High School is considered.

Trials of Localities of growing Seed (Dakota).

Owing to the poor cropping-power of the line of Arran Chief potatoes used in the previous series a commencement was made with a further series of trials in the 1932–33 season in which the Dakota variety was used. The fact that Arran Chief is relatively susceptible to mosaic, while Dakota is more susceptible to leaf-roll, and the high-yielding capabilities of Dakota were the main reasons for using the latter variety. Apart from the Rangiora district, in which the central yield trials at the Rangiora High School are to be continued, all the districts selected for growing seed for trial were those having cooler or more vigorous summer conditions than the main potato-growing districts of the South Island. Such districts were—Culverden, Sheffield, Highbank, and Pleasant Point (in Canterbury); Tahakopa (in Otago); Waipounamu, Tuatapere, and Winton (in Southland).

The arrangements for having seed grown in each of the above districts and forwarded each year for inclusion in the central yield trial were the same as those adopted for the Arran Chief series.

It is not intended to discuss the results which have already been obtained in the 1933 34 season until further trials have been carried out. The results, however, confirm those in the Arran Chief series in that marked differences occurred both in virus incidence and yield, the latter being related inversely to the former.

Percentages of virus infection ranged from 7·3 per cent. to 69 per cent., and the difference in yield from the crops showing these extremes of virus was in the nature of 3 tons of table and 2 tons of seed potatoes. Such differences are remarkable in view of the fact that they have been obtained from seed "once removed" from an original line.

Summary.

Three series of experiments to investigate the effect of locality in relation to seed-potato production are described.

Part of a line of Arran Chief potatoes was grown in Southland and part grown at the Ashburton Experimental Farm. In each of the four seasons 1927–28 to 1930–31 the seed grown in each locality was compared in a yield trial. In the last two seasons seed "once grown" from Southland—*i.e.*, grown at Ashburton for one season after having been grown in Southland—was included, while in the 1930–31 season's trial seed "twice grown" from Southland was also included in the yield trial.

In three seasons Southland-grown seed was significantly higher in yield than seed continuously grown at Ashburton. In both seasons where

seed "once grown" from Southland was compared with seed continuously grown at Ashburton the former was significantly higher in yield. In the 1930–31 season's trial Southland-grown seed was significantly lower in yield than seed "once grown" from Southland, and was not significantly different from "twice grown" seed.

In a second series of trials a line of Arran Chief potatoes was divided up and portions grown in the following districts: Willowbridge, Rangiora, Cheviot, Highbank, and Fairlie (in Canterbury); Alma and Balfour (in Otago); and Winton (in Southland). In each of three seasons (1930–31 to 1932–33) seed from each crop was included in a central yield trial. The disease counts (virus infection) taken on these trials indicated progressive increases in percentage of virus infection from seed continuously grown at Willowbridge, Rangiora, Alma, and Cheviot respectively. Potatoes grown from seed raised at Highbank, Fairlie, Balfour, Annat, and Winton respectively showed no increase in the amount of virus during the period of trial. Such differences in virus infection were reflected in the yields, although unfavourable seasons combined with the poor cropping-power of the line of potatoes used precluded any large increases. Even then the differences between the best line and the worst line in total potatoes were—1930–31, ½ ton; 1931–32, 1·9 tons; 1932–33, 2·4 tons.

The districts producing seed giving rise to crops relatively low in virus infection and relatively high in yield were those which by reason of latitude or altitude were possessed of cooler climates than the district supplying the remaining lines under trial.

A third series of trials (uncompleted) in which the Dakota variety is being used are described. The first year's results substantiate those secured in the second series of trials and differences both in virus and yield are far more markedly in favour of seed from cooler districts, such as Sheffield and Highbank (Canterbury), Tahakopa (Otago), and Waipounamu, Tuatapere, and Winton (Southland).

Acknowledgments.

The first series of trials was initiated by Mr. J. W. Hadfield, Agronomist, and carried out at the Ashburton Experimental Farm by Mr. R. Thomson, Assistant in Agronomy. The second and third series, also suggested by Mr. Hadfield, were carried out by field officers under the direction of Mr. R. McGillivray, Fields Superintendent, Christchurch, and Mr. R. B. Tennent, late Fields Superintendent, Dunedin. Thanks are due to those farmers mentioned who co-operated in carrying out the first two series of trials and to those who are still assisting in the third series. Special mention should be made of the willing co-operation of the authorities of the Rangiora High School for the use of land and facilities over a number of years.

—A. W. Hudson, Crop Experimentalist.
—J. W. Woodcock, Assistant Crop Experimentalist.

By special order, barberry and broom have been declared noxious weeds by the Pohangina County Council.

By resolutions which were gazetted from the 10th to 31st January last responsibility for the administration of the Noxious Weeds Act has been assumed by the Buller, Matamata, Waipa, Tauranga, Raglan, Waikato, and Whakatane County Councils.

SELECTION OF STARTER CULTURES FOR CHEESE-MANUFACTURE.

A PRELIMINARY NOTE ON A NEW METHOD.

H. R. WHITEHEAD and G. A. COX, Dairy Research Institute (N.Z.), Department of Scientific and Industrial Research, Palmerston North.

THE most important property of a good starter culture used in the manufacture of Cheddar cheese is its power to produce acid steadily throughout the making process and at a regular rate from day to day. It is desirable also that the culture should have a clean flavour and pleasant aroma; but, given adequate facilities for the maintenance of starters, this is relatively easy to obtain. Failure, either sudden or gradual, to attain the requisite acid production is by far the commonest fault in starters, and is one of the most important single factors causing spoilage of cheese.

The preparation and selection of cheese starters have for long been a matter of trial and error. All pure and active cultures used in commercial factories are mixtures of several varieties of lactic streptococci: but up to the present the bacteriologist has had no adequate means of deciding whether all the varieties were essential members of the culture, and, if not, which varieties were responsible for the activity of the starter.

Most of the varieties of streptococci in starter cultures can be shown by their sugar reactions to belong to one or other of the two species *Str. cremoris* and *Str. lactis* originally described by Orla Jensen. The few remaining varieties are betacocci and are responsible for the volatile acid and flavouring substances which give the starter its aroma. The betacocci are essential members of the flora of a butter starter where aroma is more important than acid production, but it is doubtful whether thay have any significant function in a cheese starter.

Although the majority of the streptococci present in starter cultures can be classed as *Str. cremoris* or *Str. lactis*, the organisms of both species can be divided into several sub-groups on the basis of colony type, microscopical appearance, sugar fermentations, and acid production. Work at this Institute during several years has been based on an endeavour to correlate any or all of these properties with the acid-producing characteristics of mixed cultures under the conditions of cheese-manufacture.

The general method followed has been to plate out starter cultures on various media, to pick off at least fifty colonies and to attempt to classify the strains thus isolated into groups on the basis of the properties mentioned above. It has been observed that most commercial cultures contain at least three or four varieties of streptococci, and that the proportions of these varieties in the population of the whole culture change markedly from time to time even when the starter is subcultured daily under conditions maintained as constant as possible. Up to a few months ago, however, it did not seem possible to find any connection between population changes or the properties of individual varieties and the properties of the starter cultures as observed by the practical cheesemaker.

Recently, however, investigation of starter streptococci on the basis of a property the importance of which has not hitherto been realized, has opened up a more promising line of work. This new field of inquiry was opened up through the observation that in pure cultures of streptococci there sometimes was a marked lack of correlation between the acid-producing power of certain strains and their ability to bring about a reducing potential in milk, as judged by reduction of methylene blue. Some strains which produced acid quite rapidly in milk at 20° C. or 30° C. decolorized methylene blue rapidly at 37° C.; others, equally rapid acid producers as judged by their power to clot milk, were exceedingly slow in reducing methylene blue at 37° C. (The use of these particular temperatures was in the first place accidental.) When reductase tests of the various pure strains were conducted in duplicate at 30° C. and 37° C. it was observed that all strains which clotted milk readily, decolorized the blue rapidly at 30° C. At 37° C., however, some of these strains were exceedingly slow in bringing about reduction, whereas the others were equally active or only slightly less active than at 30° C.

A microscopic examination of stained smears prepared from the reductase tubes provided a ready explanation of the phenomenon. In all cases where the blue was reduced rapidly the streptococci had a normal appearance and showed active growth. In those tubes in which reduction of the blue was markedly delayed at 37° C. the cocci had a distinctly abnormal appearance; they showed numerous involution forms besides a very much feebler growth. It was apparent that some strains found 37° C. so near to their thermal death-point that they survived only with difficulty.

Now in the manufacture of Cheddar cheese, the mixture of curd and whey in the vat is at one stage raised to a temperature of 37° C.–39° C. (98° F.–102° F.) and maintained at that temperature for 1½ to 2 hours. If a preponderance of the streptococci in the starter were injured by that temperature, one would expect acid-production to be considerably delayed after the application of the heat. Thus the observation in our reductase tests seemed to provide a possible explanation for the fact that some commercial starter cultures are exceedingly slow in developing acid in the curd during the later stages of the cheesemaking process.

The matter was next tested out by the selection of pure strains of streptococci which could be used as starters in the cheese vat. In a mixed commercial culture there are many strains which do not clot milk readily at 20° C. in pure culture; evidently these cannot be used alone as starters since they do not grow rapidly enough whether they withstand a temperature of 37° C. or not. Of the strains which produced acid rapidly at 20° C. several were tested in the cheese-vat. It was found that many of these pure cultures made quite satisfactory starters as judged by appearance, taste, and aroma. They were naturally not as fully flavoured as good butter starter, but they were clean and unobjectionable. As had been predicted from the results of tests in the laboratory, their behaviour in the cheese-vat depended upon whether they could survive and grow normally at a temperature of 37° C. Those types which withstood 37° C. without harm gave excellent results, the acid developing progressively right up to the salting stage. Those types which were damaged at 37° C. produced acid normally during the early part of the cooking period, and the

manufacturing process appeared to proceed normally until the whey was run off (dipped). The low acidity shown by the whey immediately after the curd was dried (piled) was unmistakable evidence, however, of a slowing in acid-production, and this slowness persisted throughout the remainder of the manufacturing process.

Several strains of streptococci which produce acid actively and withstand a temperature of 37° C. were isolated from various commercial starter cultures. They have been used during the past three months in several commercial factories and have in general proved to be very active acid formers. The only trouble has been that in certain cases with no warning they have suddenly failed to produce acid. This has been proved in one or two instances to be due to the phenomenon described by Whitehead and Cox(1) whereby in certain circumstances (undefined at present) an aeration of the starter-milk after pasteurization renders it inhibitory towards the lactic streptococci. This trouble, in factories where it occurred, seemed to coincide with the prolonged dry weather conditions during this season, but whether there is any causal connection is doubtful at present.

In spite of the occurrence of this still unexplained sudden failure, the method described for selection of pure strains is undoubtedly a definite advance in the selection of starter organisms and provides in general a most successful means for the preparation of really active cheese cultures. The organisms selected must have two properties—(1) They must be active acid formers at temperatures of 20° C. to 30° C.; (2) they must be relatively unaffected in their growth and morphology at 37° C. The two properties are to some extent complementary. One strain may be an extremely active former of acid and yet be somewhat adversely affected by a temperature of 37° C. Another strain may be somewhat less active as an acid-producer but be entirely unaffected by the high temperature. The two strains must be subjected to a vitality test(2) in order to determine which will be better in the cheese-vat. In the preliminary work of selection, however, it is possible to exclude quite easily a large number of strains which either do not form acid at a reasonable rate or which are seriously affected at 37° C.

REFERENCES.

(1) Whitehead and Cox: *Jour. of Dairy Research*, 1934, 5, 197.
(2) —— *N.Z. Jour. of Science and Tech.*, 1932, 13, 304.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 13th December, 1934, to 24th January, 1935, include the following of agricultural interest:—

No. 73023: Cutting bracken; C. M. Collins. No. 72145: Teat-cup; H. F. Taylor. No. 72980: Slicing meat; W. J. Caldwell. No. 73054: Centrifugal separator; Aktiebolaget Separator. No. 71101: Hay-sweep; H. R. Wilton. No. 72192: Cooling and deodorizing milk; J. H. Bishop and A. H. Beadle. No. 72198: Butter-box; W. H. Parker. No. 72206: Threshing-machine; F. R. Eaden and Andrews and Beaven. No. 73101: Treatment of wool; Wool Industrial Research Association, A. T. King and R. A. E. Galley. No. 73109: Grubbing-implement; A. H. Warren. No. 73129: Grain-scouring machine; C. C. Marston. No. 73170: Wire straining and fastening machine; E. T. James.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

VARIETIES OF FRUIT-TREES FOR COMMERCIAL ORCHARDS.

Horticulture Division.

TEN years ago a list of the most suitable commercial varieties of pip and of stone fruits was published in the *Journal* and in Bulletin No. 84. After consideration of developments in the meantime the amended list, given below, has been prepared recently as one which might form a basis on which to compile a planting-list. For further information about the establishment of orchards, reference may be made to Bulletin No. 84, an amended edition of which is now being obtained :—

Apples *for Export and Local Markets—Dominion List.*

Beauty of Bath.	*Delicious.
Red Astrakhan.	Dunn's (Monroe's Favourite).
Lord Suffield.	Lord Wolseley.
*Gravenstein.	Cleopatra.
Scarlet Pearmain.	Rome Beauty.
Worcester Pearmain.	Granny Smith.
*Cox's Orange Pippin.	Sturmer.
Alfriston.	*Dougherty.
Jonathan.	Ballarat.
Reinette du Canada.	

Pears—*Dominion List.*

Buerre Bosc.	Giblin's Nelis.
Beurre Clairgeau.	Glou Morceau.
Beurre d'Anjou.	Josephine de Malines.
Beurre Diel.	Marie Louise.
Louise Bonne of Jersey.	Twyford's Monarch.
Doyenne du Comice.	Packham's Triumph.
Directeur Hardy.	Winter Cole.
Durondeau.	Winter Nelis.

The following varieties may also be grown with satisfaction in localities having canning facilities :—

William's Bon Chretien.	Keiffer's Hybrid.

Peaches—*Dominion List.*

D. denotes dessert ; C., canning ; W., white flesh ; Y., yellow flesh ; F., freestone ; Cl., clingstone ; S.Cl., semi-clingstone.

Early Varieties.

Mayflower. D.W.Cl.	Briggs's Red May. D.W.F.
Sneed. D.W.F.	High's Early Canada. D.W.S.Cl.
Sanders. D.W.F.	Eulates. D.W.F.

Second Early.

Hales. D.W.F.	Husted's Early. D.W.F.
Wiggins. D.W.F.	Ideal. D.C.Y.F.
Carman. D.C.W.S.Cl.	Peregrine. D.W.F.
J. H. Hale. D.C.Y.F.	Early Crawford. D.C.Y.F.

* Red strains of these varieties are available and are preferable to the older types.

Mid-season.

Foster. D.C.Y.F.
Muir. D.C.Y.F.
Kalamazoo. D.C.Y.F.
H.B. American Pound. D.W.F.
Royal Charlotte. D.C.Y.Cl.
Kia Ora. D.C.Y.F.
Paragon. D.C.Y.Cl.

Late Mid-season.

Gold Dust. D.C.Y.Cl.
Sea Eagle Impd. D.W.F.
Mary's Choice. D.C.Y.F.
Akarana. D.W.F.

Late Varieties.

Lippiatt's Late Red. D.W.Cl.
Golden Queen. D.C.Y.Cl.
Late Crawford. D.C.Y.F.
Solway. C.Y.F.
Hobb's Late. C.W.Cl.
Pullar's Cling. C.Y.Cl.
McDevitt's Late Cling. C.Y.Cl.

Nectarines—*Dominion List.*

Ansenne.
Cardinal.
Early Rivers.
New Boy.
Goldmine.
Hunt's Tawny.
Victoria.

Plums and Prunes—*Dominion List.*

English.

Angelina Burdett.
Coe's Golden Drop.
Damson Russian.
Diamond.
Early Orleans.
Early Rivers.
Evans Early.
Grand Duke.
Greengage.
Jefferson.
Kirke's.
Magnum Bonum (Yellow).
Monarch.
Pond's Seedling.
President.
Takapuna Drop.

Japanese.

Burbank.
Billington's Early.
Doris.
Formosa.
October Purple.
Santa Rosa.
Satsuma.
Wright's Early.
Sultan.

Prunes.

Golden Prune.
Giant.
Petite d'Agen.
Tragedy.

Apricots—*Dominion List.*

Bolton.
Hemskirk.
Moorpark.
Newcastle.
Oullin's Early.
Royal Late.
Roxburgh Large Red.

Cherries—*Dominion List.*

Biggareau Twyford.
Early Purple Guigne.
Early Rivers.
Black Eagle.
Biggareau Jabaulay.
Florence.
Black Tartarian.
Biggareau Napoleon.
May Duke.
Early Lyons.
Bedford Prolific.
White Heart.
Knight's Early Black.
St. Margaret (Black).
Werder's Early Black.
Governor Wood.
Bing.

SEED-WHEAT CERTIFICATION.

CERTIFIED CROPS.

UNDER the Government scheme for the certification of seed wheat, the following growers have seed for sale from crops which have passed both field and grain inspections:—

Variety.	Grower.	Acreage.
Cross 7	R. H. Johnston, Dunsandel (contract to Canterbury Seed Co.)	5
Solid Straw Tuscan ..	W. T. Bell, Prebbleton	15
	C. Early, Templeton	20
	R. H. Johnston, Dunsandel	44
	F. A. Tutton, Christchurch–Springston R.M.D.	13
Marquis	*W. Ives, Old Renwick Road, Blenheim ..	5
	*W. A. Litchfield, Middle Renwick Road, Blenheim	12
Hunters II	*G. Fine, Springs Road, Sockburn	18

* Passed subject to machine-dressing of seed.

—*Fields Division.*

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SEASONAL NOTES.

THE FARM.

Some Considerations relative to Seed-mixtures.

THE purchase of seed-mixtures for the sowing-down of pastures is an important task with which many are faced at this season. The task may be resolved into two main phases: (1) The determination of the particular species and the amount of each to be used, and (2) the economical purchase of suitable seed of the various species required. Assurance of attaining full efficiency in respect to each of these phases can be obtained only by taking into consideration the available knowledge relative to recent developments.

Composition of Seed-mixtures.

One of the outstanding features of modern thought relative to seed mixtures is the trend towards ever greater simplification. The distance travelled in this respect is reflected in a comparison of a mixture approved in the Dominion to-day for extensive use and a mixture of the Clifton Park system of farming which attracted so much attention a few decades ago, which still is accorded respect, and which seems to have influenced considerably the mixtures prescribed in the past for use in New Zealand. The following plants were included in a mixture typical of those sown under the Clifton Park system: Cocksfoot, tall oat grass, golden oat grass, tall fescue, meadow fescue, hard fescue, rough-stalked meadow grass, smooth-stalked meadow grass, Italian rye-grass, kidney vetch, chicory, burnet, sheep's parsley, yarrow, late flowering red clover, white clover, alsike—seventeen species in all. Probably this mixture was seldom if ever duplicated exactly in New Zealand practice, but one of its important features—the inclusion of a wide range of plants—certainly was copied extensively. Against the typical Clifton Park mixture may be considered a mixture which is being used widely in the Dominion with good results and which consists of rye-grass, cocksfoot, dogstail, red clover, and white clover. Though this involves a reduction from seventeen to five species, the question whether in the establishment of permanent pasture it would not prove advantageous at times to reduce the number of species still further is now being asked. Investigations and field experience both in New Zealand and overseas suggest the advisability of employing more freely still more simple mixtures designed to cater especially for a particular season and also usually to fill a particular need. An instance of the successful application of this conception is provided in the so-called "special paspalum pastures," in which *Paspalum dilatatum* is dominant and from which decidedly valuable supplies of leafy feed have been obtained from midsummer into the autumn in the warmer districts to as far south along the coast as Foxton and, may be, occasionally in localities farther south. Another instance, which is not quite a parallel because the key plant is an annual, but which is analogous in essential respects, is the successful use for special purposes of pastures in which subterranean clover is dominant: subterranean clover has for long been observed under normal grazing management in competition with common pasture plants such as rye-grass, cocksfoot, dogstail, brown-top, and other clovers, and generally has been considered as of insignificant value if not as a weed. But subterranean clover, grown with competition so reduced that it dominates the sward and grazed leniently at seasons when in competitive positions it is grazed severely, has been found to be of outstanding value under certain conditions. Experience with lucerne also is suggestive relative to the simplification of pasture mixtures. Lucerne falls off in yield when in competition with plants which make their maximum

growth at a season different from that in which lucerne makes its maximum growth, and eventually such competition may make it inadvisable to persevere with a lucerne area. Again, defoliation of lucerne when the growth is leafy and immature—*i.e.*, appreciably in advance of its flowering—lessens its vigor and yield, and if such defoliation is carried out frequently enough it may be expected eventually to make even a vigorous stand of lucerne valueless. To sum up it is known from extensive field experience that certain plants such as paspalum, subterranean clover, and lucerne under certain circumstances become of outstanding value for special purposes: the circumstances of competition and of time and method of defoliation govern the value of the plants just mentioned. There is much evidence that a similar position holds in respect to pasture plants generally. For instance, work at the Welsh Plant Breeding Station indicated that the previous defoliation of cocksfoot has a very marked effect on its yield: two areas of cocksfoot were cut three times and eleven times respectively in a certain period. In a subsequent specific period the yield of the area cut three times was nearly fourfold that of the area cut eleven times. While this may be taken as an extreme result it serves to indicate the substantial bearing of the manner of defoliation upon the yield of cocksfoot. New Zealand work by D. A. Campbell illustrates a similar relation between red clover and the manner of its defoliation. In an area which had been subjected to controlled grazing, red clover occupied from 80 per cent. to 100 per cent. of the ground in the second season, while in a corresponding area which had been subjected to close and continuous grazing the red clover occupied only 15 per cent. of the ground, while weeds and bare ground accounted together for 35 per cent. of the ground. Exact results such as these coupled with analogous results observed on a field scale assist in explaining the origin of the very divergent opinions at times expressed about the value of various pasture species. For instance, some eulogize cocksfoot just as confidently as others condemn it on the basis of the results they have obtained. Actually, under moderate to good fertility, if the grazing is sufficiently lenient, cocksfoot widely will outyield rye-grass, whereas if the grazing is relatively severe and continuous the rye-grass will outyield the cocksfoot. Considerations of this kind indicate that under the methods of grazing which to-day dominate our farming certain valuable plants often are not exploited to the best advantage, and it may be deduced that simpler seed-mixtures at times would enable these plants to be employed with more effect. For instance, the creation of a sward dominated by cocksfoot and red clover—both relatively late in their season of growth—not only contains the promise of a supply of leafy feed when it is specially valuable but also obviates the difficulties associated with the correct management of a sward in which plants of early and of late growth are equally prominent. It has been shown that pasture plants are most susceptible to weakening by overgrazing during the early stage of active growth. If a pasture consists principally of plants which coincide in their season of growth, then these plants can be strengthened substantially by being allowed to grow unchecked by defoliation during the early stage of active growth. In a mixed pasture, however, plants defoliated at the critical time of early active growth suffer more severely than similarly defoliated plants already past the critical stage, but some difficulty arises in the planning of grazing which eliminates the avoidable defoliation of plants at the critical time of early active growth. From this is does not follow necessarily that early and late species in the one sward should not be sought, for considerations other than ease of grazing management call for attention; but it is clear that the occurrence of early and late plants in the one sward involves certain disadvantages, and the question arises whether suitable simplification of seed mixtures should not be resorted to under certain circumstances to obviate these disadvantages. Such a line of thought diverges sharply from the thought upon which was based the Clifton Park type of mixtures. The wide range

of plants included in these mixtures arises to some extent at least from limitations in the available knowledge. In endeavouring to ensure the presence of all necessary ingredients, ones which are unnecessary and which can be omitted without harm are included. In the light of present knowledge the Clifton Park type mixture is now deemed out of date and unnecessarily costly, but exactly how far along the path of simplification of mixtures it is economical to go has not been established.

Need of adapting Mixtures to Management.

In last month's notes reference was made to the role of top-dressing in determining the composition of pasture seed-mixtures for use in regions of satisfactory rainfall—say, 30 in. or more –and herein some indication has been given that the time and method of grazing and mowing play a part in determining what is the most suitable composition of a sward. In short, the management to which a pasture is to be subjected is often a much more important matter in drawing up a pasture seed-mixture than is the type of soil on which the seed is to be sown. This being so, it is not altogether reasonable to expect maximum success for pasture seed-mixtures which have not been based upon specific planning and study of local conditions. Guidance relative to the constitution of individual seed-mixtures may be obtained from district officers of the Fields Division who have the required knowledge of local conditions.

Economical Purchase of Pasture Seed.

At the time of writing, the number of samples of seed of the current season which have been tested is not great enough to indicate definitely the standard of the whole new crop, but the promise is that generally the germination capacity of the seed will be unusually high. However, as is customary, occasional lines which fall considerably below the general level illustrate the advisability of purchasing on the basis of guaranteed germination and purity so as to avoid being supplied with one of the low-testing lines at substantially the same cost as a high-testing one. In view of the facility with which seed of low germination seems to be sold, it appears to be worth mentioning that while examination by eye may enable the purity of seed to be gauged satisfactorily it is quite unreliable as a means of assessing the germination capacity of seed.

That the advisability of using suitable strains of some of the more important pasture plants is being popularly realized is due to the extensive field evidence of the superiority of these strains in the conditions for which they are designed and is indicated by the growing use of certified seed which is the only means of assuring a supply of the superior seed which is desired. One result of the increased attention being given to certified seed is that at times uncertified seed is being offered as "just as good as certified." While in some instances such seed may warrant this claim the odds are that it does not: it is surely reasonable to expect that growers producing seed eligible for certification will take the necessary simple inexpensive steps to bring it under certification and thereby obtain the enhanced returns which certification begets. At any rate, usually it is difficult if not impossible for the purchaser of such seed to assure himself of the real worth of seed not bought under certification. On the other hand, provided certified seed is bought with due attention to its purity and germination, there is assurance that the seed possesses a superiority in certain valuable characters which is not likely to be possessed by any line of uncertified seed of the same species. It seems sometimes to be overlooked that germination capacity is not one of the factors determining certification, and that the germination of various lines of the same kind of certified seed may vary greatly. And while certain restrictions relative to purity attach to certification, certified seed may vary materially in its purity within these restrictions. Because of these facts it is just as advisable to buy certified seed as other seed under guarantees of germination and purity.

Further information about pasture establishment and about the detailed composition of seed-mixtures appears in this *Journal*, February and August, 1934.

Surveying of Future Feed-supplies.

Especially in an unfavourable season such as this is in many localities it is often useful at this stage in the year's work to consider the future position in respect to feed. At times, because of the abnormally dry conditions, inroads have already been made in the supplies of silage originally intended for consumption principally in winter and spring. Further, it seems likely that the pastures will enter the period of low rate of growth in a barer condition than normally, and reserves of supplementary fodder crop promise to be lighter than usual. As, commonly, the reserves of winter and spring feed are undesirably scant, the promise is that a normally unsatisfactory feed position will be worse than usual unless suitable steps are taken to augment the prospective supplies of feed.

Of the measures which may be adopted to improve the position, late summer or early autumn top-dressing with phosphates, especially superphosphate, and, in suitable districts, basic slag, well deserve pride of place under the conditions of rainfall and warmth that are associated with successful autumn response by grassland to these fertilizers. Quite an important feature of February to April top-dressing is that it usually brings about a substantial increase in valuable growth prior to the practically dormant winter period. If the top-dressing is sufficiently early this increase may be especially valuable this year in maintaining dairy production towards the end of the producing-season. In the view of the prospective scant supplies of winter feed any additional growth of grassland in April and May will be particularly useful this year as an aid towards securing good condition in the stock prior to entering upon the relatively severe season of the year.

In cases in which limitation in the amount of top-dressing that is practicable necessitates the exclusion of some pastures on a farm from the autumn top-dressing programme, then two classes of pastures should be given priority in attention. Firstly, the better-class pastures, such as those relatively rich in vigorous rye-grass, cocksfoot, and clover should be top-dressed in preference to inferior ones. Though, comparatively, the response from good and from poor pastures may be equal the former normally have capacity for greater net or absolute response to top-dressing. For instance, a 20-per-cent. increase in a pasture of four sheep an acre carrying capacity is in terms of net feed units just double a 20-per-cent. increase in a pasture of two sheep an acre carrying capacity. Secondly, young pastures should as a rule be selected for attention in a restricted top-dressing programme in preference to older and possibly worn ones, and this because it is more economical generally to take proper care of young pastures and thereby to maintain them at the highest possible standard than later to have to undertake the task of repairing or renewing them.

The suitable growing of forage crops sown in late summer or early autumn may also assist usefully in providing feed when it is likely to be needed critically later on. Land from which such crops as oats, wheat, maize, millet, soft turnips, or rape have been removed recently, if sown without delay in temporary pasture, oats, or barley, in the manner described in these notes last month, may be expected to be of distinct service in strengthening the feed position. If the land to be sown in such crops is so hard as to make satisfactory skim-ploughing impracticable, then cultivation with disks set with plenty of cut will serve frequently as a satisfactory alternative to the skim-ploughing. In preparing the land for such crops it is not necessary to reduce the surface layer of soil to a fine condition—indeed, at times the occurrence of clods may be an advantage by preventing the caking of the soil that may develop in a surface layer of fine soil as a result of beating rains.

Grass-harrowing as soon as good rains occur is another means at this stage of fostering the production of fresh leafy feed on pastures on which droppings have accumulated during the dry spell. An essential purpose of such harrowing is the distribution of droppings, and this is achieved more effectively by two strokes of the harrows, one at right angles to the other, than by a similar amount of harrowing carried out in any other manner.

Utilization of Crops.

Often during March a cut of hay or green feed is available from areas of lucerne. After such a cut, if weeds are a menace and if dry conditions prevail, it is likely to be advantageous to give the crop a stroke of the tine-harrows or of other harrows fitted with teeth possessing the fine points required to avoid undue injury to the lucerne plants. There is an occasional tendency to look upon cultivation as a routine part of the culture of lucerne. Actually, at times more harm than good has been done to lucerne crops by ill-considered surface-cultivation. Relative to this, before cultivation is begun an attempt should be made to gauge the prospects of materially reducing the invading weeds without at the same time correspondingly injuring the lucerne by cultivation. If the cultivation needed to reduce the weeds satisfactorily has to be so severe that lucerne plants are freely destroyed, then the lucerne area may become so thinned eventually as not to warrant persevering with it. Because of the resultant thinning the use of implements which cut the main roots of lucerne is as a rule inadvisable.

Every year some areas of maize and of millet are allowed to become too woody or are cut down by frosts. Generally it is advisable to utilize them earlier and at times to employ the land thereby made vacant in growing one of the fall-sown forage crops mentioned above. Maize or millet that cannot be used effectively as green feed should be conserved as silage, provided the amount available is sufficient to make this worth while, having due regard to the relatively high proportion of waste associated with small quantities of silage.

Autumn Tillage.

Autumn cultivation well warrants widespread attention. Frequently land on which cereals and rape have been grown should be cultivated as soon as practicable after the removal of these crops. Such cultivation tends to weaken or destroy perennial weeds, and to encourage the development and eventual destruction of seedlings of certain annuals. Further the cultivation by improving the fertility of the soil fosters greater rapidity of growth and vigour in crops subsequently sown in the autumn, and thereby incidentally makes such crops able to compete more successfully against annual weeds which germinate in the spring.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Control of Pests and Diseases.

An appreciable rainfall during the month of February or prolonged occurrence of humid conditions increases the danger of a late infection of black-spot, and when these are experienced an application of the usual combination-spray should be made later in the season than is otherwise necessary. This spray applied in early March often prevents serious losses on late varieties such as Dougherty and Sturmer.

Where summer oil has not yet been applied for the control of red-mite, two applications at a dilution of from 1 per cent. to 2 per cent. should be made as soon as possible. An interval of ten days between the applications is desirable. About fourteen days should be allowed to elapse before applying summer oil following a sulphur spray.

At this season late varieties of stone-fruit require spraying, as recommended in these notes for December last, particularly for the control of brown-rot. The frequent gathering and destruction of all diseased fruits, both on the trees and on the ground, will assist very appreciably in the control of this disease.

Handling Fruit for Export.

If the best results are to be obtained, the utmost care and skill is necessary in every operation in which the handling of fruit is involved. Although speed is essential it should not be striven after to the extent that the ultimate out-turn of the fruit will be deleteriously affected. In the packing-shed there should be as much space as possible provided for every operator. Congestion frequently necessitates double-handling of the fruit, which increases costs. Good lighting is also essential for good work, particularly for the graders and packers. Sky-lights are far more satisfactory than any number of side windows, as the latter almost invariably produce shadows which conceal some portion of the fruit that otherwise would be visible to the operator. It is suggested that fully 50 per cent. of the below-standard fruit that is inadvertently included in cases of fruit prepared for export is due to inadequate lighting.

Machine graders will require frequent cleaning to remove accumulations of oily matter which forms into hard lumps, liable to bruise the fruit. The frequent cleaning-out of the bins is important, as also is general care of all moving parts, to ensure good running order. The over-filling of bins is frequently the cause of stem-punctures and bruising. As the case is being packed it is important that the packer should apply pressure with the hands at the ends of the case. This practice is necessary to keep the ends low and at the same time permit of a good bulge in the centre of the case. The turning of the fruit in the right direction on the top tier should also be insisted upon. It is a good practice for the person attending to the nailing-down to be in some way held responsible for any damage resulting from that operation. This will, in a large measure, prevent the nailing-down of cases that have not been well packed. Cases packed with the fruit too high at the ends should be specially guarded against as this fault in packing is largely responsible for fruit arriving at its destination in a bruised condition. A badly driven nail often results in trouble ; if projecting inwards a fruit may be punctured ; if outwards possibly an injured hand or a dropped case. Especially in loosely packed cases, care is necessary in operating the lidding press to see that the fruit along the sides and ends are not cut on the edges of the case.

The outward appearance of the cases should be given due attention by using only a good quality paste and the stamping of necessary particulars, such as the variety, in a clear and neat manner. The good reputation New Zealand fruit has gained on overseas markets can be maintained only by strict attention to every detail in connection with the marketing of the fruit.

Tree Supports.

At this time of the year the matter of providing necessary supports for fruiting limbs should receive immediate and constant attention. Neglect of this important work frequently results in the loss of valuable fruiting wood which will take a number of years to replace. Trees supported by a permanent system of wire bracing will at times require further attention by shifting the supports either higher or lower on the limbs, according to requirements, also further limbs may need including in the system. Props frequently require adjustments, especially following a windy period.

—P. Everett, Orchard Instructor, Gisborne.

Citrus Notes.

In those districts where exceptionally dry weather has been experienced this summer, growers of citrus fruit will need to keep their land in a constant state of cultivation, so that the surface soil is in as fine a tilth as is possible. Where mulching has been carried out either with rough litter or manure it will have helped to conserve moisture and keep down weed growth. In some groves irrigation could be employed with advantage, although as a rule it is not necessary; but it is worth the effort to supply water if by doing so one can save defoliation and loss of the crop.

As soon as autumn rains commence the trees put forth an amount of vigorous growth, and this should be "pinched" and spaced in order that the growth may become reasonably hard to withstand the frosts which may be expected with the coming of the winter.

All fruits should be harvested as they become ready and ripening fruit not allowed to develop on the trees, as this would put an undue tax on them at this period of strain.

Given humid conditions suitable for the spread of verrucosis it will be necessary to apply a further spray of bordeaux 3–4–50 if the advancing crop is to be kept clean.

—L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Culling.

MARCH generally can be regarded as the best time in which to detect and cull the hens not worth keeping for another year. In the work of culling, a good guide in distinguishing the money-makers from the drones, is to observe the time of moulting. It will be found invariably that the hens which moult first are the poor layers and the birds of weakest constitution in the flock, so that second-year hens showing the first sign that their present laying-period is coming to an end should be marketed without delay. This does not apply, however, to noted breeders: these may be kept until they are three or even four years old, providing their constitutional vigour is unimpaired. In culling a flock the wise poultry-keeper does not let sentiment influence him, but always keeps in mind the food-bill, a most important factor in the business. He not only culls all hens that have passed their second season of production, except as before stated in the case of noted breeders, but he also culls heavily the first-season layers. It should be remembered that after the first laying-season, a hen's value as a layer lessens, and after the second year she will usually produce only during the season when eggs are cheap, and thus be unprofitable to keep. Many hens die in debt to their owners because they have been kept beyond their time of usefulness, whereas if they had been culled at the right time they would have shown a good margin of profit over their keep.

When culling on the time of moulting, individual conditions should always be kept in mind, especially in regard to the time the birds were hatched out, for it is obvious that the very early hatched bird will moult in advance of one brought out on the late side. Another point that may be mentioned is that the older birds in a mixed flock of first- and second-season layers, where the latter were selected the previous season for the reason that they were late moulters, will usually, owing to their shorter season of production, moult later than the pullets which commenced to lay, say, some time in April, so that in such cases where the moulting period is taken as a guide, due allowance for the age of the birds must be made when culling. Otherwise many of the young birds which it would be profitable to keep are apt to be disposed of, and older but less profitable ones retained on the plant. On all well-managed plants a mark or ring is

placed on every bird as an indication of age, by which the old birds can be distinguished readily from the young ones, and this obviously simplifies the work of classifying the stock.

Apart from late moulting, there are other signs indicating that a hen is going to take a long period of rest, such as a loss of bloom and shrinkage of the comb, and also a shrinkage about the abdominal region, until the breast-bone comes into close contact with the pelvic bones. The latter also contract until the width between them does not admit more than one finger. In the case of yellow-legged breeds such as Leghorns, the paleness or otherwise of the shanks and beak at this time of the year affords a guide for distinguishing the heavy layers from the drones. With the heavy layer both the shanks and beak will have a well-bleached and almost white appearance, while those of the drones will be a rich yellow. It must be remembered that this applies only towards the end of a laying-season, as even with the best layers in the flock the shanks and beak will regain a rich colour after they have gone through the moulting process. Especially does this apply where the birds are running on damp land or well-grassed runs. Of course, during the pullet stage all birds of the yellow-skinned breeds should have yellow shanks, as any other colour indicates that they are not standard-bred.

Another point which serves as a good guide to a bird's productive power is that the heavy layers at this period of the year will present a more or less shabby appearance, and, owing to this fact, are often the first to be culled out by the inexperienced poultry-keeper. With the exceptionally heavy layer it is not uncommon for the plumage to present an unkempt appearance. This particularly applies to the tail feathers which become more or less broken and worn down as a result of frequently visiting the nest, while the head becomes almost completely devoid of feathers, a sign seldom or never found in a low egg producer.

Generally the best layers are the thinnest birds in the flock, whereas the heaviest and best-looking are the drones. Especially does this apply to the former when the food is not supplied with a free hand. The condition of the skin surrounding the abdominal region also gives a guide to laying-power. This skin should be soft and flexible to the touch, so as to allow for contraction and expansion in accordance with the bird's laying condition. Beware of the bird that is hard and coarse to the touch around the abdominal region, as this indicates that it is converting its food into fat and flesh instead of eggs.

Summarizing the foregoing points, the birds that it usually pays to cull are those that show signs of early moulting, those with well-kept plumage and which are above the normal weight of their breed, those with hard development surrounding the abdomen, and those with points indicating a weak constitution, such as dull sunken eyes, heavy well-feathered eye-brows, bright yellow legs, loose feathering, and sluggish appearance.

When to Market.

Do not delay marketing the culls until the moult has practically set in, or until they have practically got over it. They should be marketed immediately they commence to take their rest prior to going into a moult. With the hens which show signs of being in a laying condition, and which it is intended to cull when they reach the moulting-period, forcing for egg-production is desirable in order to get all possible eggs from them in the time available. There should be no sentiment in this matter. Even if an odd bird should show the effects of the forcing condition, in the way of ovarian disorders, such as protrusion of the oviduct, it will pay to destroy it rather than retard the laying of the others. On the other hand, the birds which have been selected for next season's breeding-pens should not be forced, nor should there be any endeavour to make high egg-yields. Such birds should be kept in a healthy vigorous state, which is not encouraged by being subjected to forced

feeding for egg-production. It has to be remembered that they have the moult to go through, which is in itself a considerable strain on the constitution. This loss must be made good before the breeding-season, for if the birds are to leave vigorous progeny they must have the necessary vitality inseparable from good health before being placed in the breeding-pen.

Lameness in Young Ducklings.

Several complaints have been received lately regarding lameness and loss of leg-power in ducklings that were being reared by artificial means. This may be due to having the drinking-vessels insufficiently deep to allow the birds to get their heads well under the water for keeping their nostrils from becoming clogged up with food, &c. Another, and most common cause, is dampness in the sleeping-quarters, and allowing the ducklings to sleep on wet bedding material. Curing this trouble is out of the question, and the only safe course is to prevent it. The first step in this direction is to provide drinking-vessels which will allow the young birds to get their heads sufficiently deep under the water to give their nostrils a vigorous "blow out." Care must also be taken to keep the bedding material in a dry state, and with this in view the drinking-vessels should be placed well away from the sleeping-compartment. This will go a long way to prevent the droppings from the birds after drinking coming into contact with the bedding.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Final Extracting.

Before taking the last of the surplus honey a careful examination of the colonies should be made in order to ascertain the amount of stores available for wintering the bees. Too often beekeepers err in extracting too closely, and feeding has to be resorted to at a later period to make up the amount required to prevent starvation. It takes 30 lb. of honey to winter a colony successfully, and if this amount is increased to 40 lb. there is less likelihood of the bees being short in the spring, while the beekeeper will be saved a great deal of anxiety and endless trouble in the way of feeding.

Where extracting has been delayed for any reason it is advisable to use great caution in removing the honey. The combs should be removed as expeditiously as possible, and care must be exercised not to incite the bees to rob by keeping the hives open longer than it is necessary to remove the surplus. A rapid examination of the brood-chamber should be made in case it is found that the bees have not filled the combs in the lower story with honey. If empty or partly filled combs are found, it is highly important that they be replaced with good combs of honey from the super. On no account should an attempt be made to extract any honey from the brood-chamber. It is inadvisable to leave combs lying about or to expose vessels that have contained honey. Unless caution is exercised in regard to these details, when the final extracting is being done the beekeeper is more than likely to start the bees robbing in a wholesale manner.

Extracted Combs.

It is very bad practice to put extracted combs on the hives as soon as the honey is taken from them. If returned during the day in all likelihood robbing may be started, and, moreover, the bees will become troublesome as they seek an entrance to the honey-house. The wet combs should be placed on the hives in the evenings, as the bees will have time to clean them during the night, and any excitement caused by the return of the combs will have subsided by morning. Owing to the labour involved in carrying

out supers of combs, placing them on the hives, then freeing the combs of bees, and finally returning them to the honey-house, many beekeepers make a practice of storing wet combs. Although no definite research work has yet been undertaken to determine whether the following season's honey is affected by combs stored in this manner, it seems very doubtful whether the storing of wet combs is advisable—the moist atmospheric conditions promote fermentation of the honey in the combs, and in the course of time honey-houses become permeated with the injurious bacteria of fermentation, while the sour smell engendered cannot be considered otherwise than as detrimental to the keeping-qualities of a well-ripened honey.

It may be well to remind beekeepers that many lines of honey, while not actually sour or in a fermented condition, possess the characteristic odour so very noticeable in rooms used for storing wet extracting combs. The keeping-qualities of such honey are regarded as doubtful, and it is rejected for export. While beekeepers may be producing the maximum crops attainable under the season's conditions, the after-care of the honey, once it is in the storage-tanks, presents quite a number of problems, not the least important of which is the preservation of its natural aroma.

Bee-escapes.

For removing honey late in the season the beekeeper may find it necessary to bring into use bee-escapes. These escapes enable the honey to be removed without causing any disturbance. By the employment of the Porter bee-escapes there is less likelihood of causing robbing, with its attendant evils. More especially will the escapes be found advantageous when removing section honey from the hive. There is far more risk in removing comb honey from the hive than extracted honey. When the colony is disturbed the bees will at once start to fill their sacs, and often the cappings of the sections are punctured in order to secure a supply of honey. The damage to the cappings of sections is unsightly and causes the honey to leak after removal from the hive.

The best escape device is made in the form of a frame 20 in. long by 15 in. wide by 3 in. deep, which is covered by wire gauze, and one or two escapes fitted into it. In inserting the escape gently prize up the super from the brood-chamber and insert the board. A puff of smoke will suffice to control the bees whilst the operation is being performed. If this is done late in the afternoon the bees will pass through the escape during the night to the brood-nest, and will be unable to return. In the morning the supers may be removed, when practically no bees will be left in them.

A word of caution to those who have not formerly used the escapes: Should there be brood in the super combs the bees will not leave, and the escapes will not prove effective in ridding the supers. Over and over again many beginners complain that they cannot get the bees to leave the supers when using escapes; but the reason lies in the fact that no examination had been made to ascertain beforehand whether the super contained honey only.

Uniting Colonies.

In the autumn work requiring attention is the examination of the colonies for the purpose of ascertaining if each possesses a laying queen, and of noting those that are too weak to survive the winter. In the negative in either case it is advisable to unite the colony with a stronger one to save the bees. On no account should an attempt be made to winter weak hives, as they are likely to get robbed out, and this may cause the bees to start robbing generally when everything in the apiary should be quiet.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

THE full enjoyment and economical use of many vegetable crops does not depend only on a wise selection of varieties and careful culture: similar consideration must be given to harvesting and storage if there is to be no loss in quantity and quality and the stocks are to be available over a maximum period. Under our conditions celery, parsnips, salsify, artichokes, autumn-sown carrots, and beet may be left in the ground and lifted as required with satisfactory results until about the month of August, when growth is about to recommence. They must then be lifted and stored where the conditions are cold, well ventilated, and not too dry. Main-crop carrots, maturing about the month of April, will split if left in the ground, and become coarse and fibrous, as will main-crop beet maturing at that time. These should be lifted in fine weather as soon as they mature and given the storage conditions mentioned above.

A lean-to shed with a southerly aspect is often a suitable place, especially when shaded by plantation trees. Such a place is also suitable for potatoes, stored in bins, sacks, or boxes, if it is clean and well drained, but not so dry as to cause the tubers to shrivel. There will be losses from decay if the stocks are contaminated by the presence of decayed tubers or waste carried over from a previous season in the store or its vicinity. This can be avoided by the methodical disposal of decayed waste at all times, and an annual clean-up which may very well include a through spraying of the interior of the store with a reliable fungicide. Losses from decay may also occur through infection caused by decayed tubers overlooked when bagging up in the field. Doubtful stocks should be picked over after a month or two in storage, and if the infection is fairly extensive they should be used up as soon as possible. Large quantities stacked in a compact manner will heat and sprout, especially in warm districts and in a store where attention to ventilation is neglected. In such localities they may be stored satisfactorily in slatted bins to a depth not exceeding 3 ft. or 4 ft., but in colder districts 6 ft. may be a maximum depth. Where stocks are large and storage accommodation limited a quantity for late use may be pitted if the tubers are quite sound. For this purpose a well-drained cool position should be chosen and the pit made not more than from 5 ft. to 6 ft. wide and the tubers piled as high as possible. If these conditions are observed and the potato crop is dug carefully in fine weather so soon as it is ripe, and allowed to harden off for a few hours before gathering, it will be used to best advantage.

Onions should be lifted as soon as they are ripe and placed in windrows, consisting of five or six rows of onions, until the tops wither completely. If humid weather is experienced the windrows should be turned over; for this purpose a wooden rake is suitable. When thoroughly dry the tops should be trimmed off with shears and the bulbs bagged up or placed in slatted crates and stacked in an open shed for a few weeks to cure thoroughly before storage or shipping. When cured the bulbs should be cleaned by the removal of the dry outer scales, thick necks, and decayed or injured bulbs, and graded to size. They will then store satisfactorily if placed in a dry atmosphere that is cool, with an even temperature, and given thorough ventilation at all times except in wet or humid weather. If stored in slatted boxes they are stacked, like fruit, with a 1 in. space between tiers and rows to permit of the circulation of the air. Or they may be spread 6 in. or 8 in. deep on slatted shelves. Or small quantities may be "strung" and hung in a dry airy place in the old-fashioned manner. The bulbs quickly deteriorate in a close atmosphere.

Vegetable marrows are best used in a green state when of a suitable size, but pumpkins, and what are known in America as winter squash—such as the Hubbard varieties—should be harvested not until thoroughly ripe

but before they have been frosted. They should be cut with a portion of the stem attached to the fruit and left in the field to mature before carting. They must then be handled and carted with care, as they are easily injured seriously at this stage. Stored in a warm, dry, airy place for a few weeks the shells harden up and they will then stand somewhat lower temperatures and rougher handling if that is necessary.

In the warmer districts, especially where there is a heavy rainfall, the ordinary late potato crop is rather difficult; but the sweet potato or kumara generally grows well. For this and other reasons it is increasing in popularity in such areas. While the crop is best left growing as late as possible, it must be lifted before there is any frost or the tubers immediately under the crown are liable to injury. If frost kills the vines the kumaras should be dug immediately as decay sets in on the dead vines and may pass down to the roots. Digging must be done with the greatest care as the slightest damage at this stage prevents the tubers keeping. Storage losses are chiefly due to faulty handling before curing. The last-mentioned operation is usually done by gathering the kumaras into heaps and covering them with sacks every night, to dry them thoroughly before storage in a warm dry chamber that can be ventilated in warm weather. Small quantities may be successfully kept by storing in sand so long as it is perfectly dry. In the southern states of America, where they are grown on a commercial scale, the roots are stored in crates, stacked to allow the air to circulate through them, in chambers that are heated to a temperature of about 80° F. for the first fortnight or so of the storage period. When the roots are well dried off the temperature is allowed to drop to 55° F. and held there for the rest of the storage period, giving ventilation freely when the weather permits. In this way, with dry beans, pickles, and chutneys, the garden makes valuable contributions to the larder during the winter as well as the summer months.

Among the young growing crops hoeing in fine weather will be required to keep down weeds. It is advisable also to select a piece of well-drained ground and prepare it, as soon as it is available for planting out spring cabbage during the month of April. It is timely to earth up celery in fine weather and sow spinach, lettuce, and onions. In the more humid districts this onion crop is of first importance; by planting out the seedlings in the month of July, or so soon after as the land may be got into condition, the crop ripens in the dry summer weather and is harvested under the best conditions. Rocca and Tripoli types are not the best onions for long distance shipping, but their tender mild qualities create a good local demand.

The Tomato Crop.

Where the tomato is one of considerable importance it will sometimes be advisable to select the seed under local conditions, so that it is not only of a type suited to one's requirements but also thoroughly acclimatized. Time and careful consideration should be given to the selection of plants from which seed is to be taken: they should be free from disease, of good constitution, and carrying crops that are as satisfactory as possible as regards quantity and quality. It is advisable to remove fruit that is likely to be coarse or small and allow the remainder to ripen naturally on the plants which should be flagged to enable them to be readily recognized. When ripe, cut the fruit open and drop the pulp into a little water. Stand it in a warm place and as soon as it commences to ferment pour it into a sieve or gravy-strainer and wash it well under a tap of running water until the clean seed only remains. Place it in a position where it will dry quickly and stir it well frequently to prevent the seeds sticking together. If the seed is stored in tins or other air-tight containers it is as well to dry it a second time after a short period, to make sure it is quite dry. It should then remain in good condition for five years at least. Another method is to scoop the seeds from the fruit and let it drop on to sand that is quite dry and has been passed through a fine sieve: rub the mixture well through the hands for some time and then spread it to dry. When dry rub it again and sieve it to remove the sand.

Sundry Fruits and Nuts.

Where plants of this kind are to be set out during the planting-season—May to September inclusive—and while the land is being prepared, details of the planting plans should be decided, and healthy plants of good moderate growth and the required varieties should be selected and ordered for delivery in the month of May, which is about as soon as they will be available. Heeled in in friable soil they will then be quite safe for four or five months, if necessary, and ready for planting out at any time.

Plants of this class include the well-known bush fruits such as gooseberry, currants (black and red), raspberry, loganberry, passion-fruit, Chinese gooseberry (*Actinidia chinensis*), Cape gooseberry, tree tomato (*Cyphomandra betacea*), loquat, avocado (*Persea gratissima*), olive, fig, pomegranate, guava, and feijoa (*Feijoa sellowiana*). The nuts which are grown here most satisfactorily are walnuts and almonds, chestnuts and hazels; also pinea nuts, as the seeds of the stone pine (*Pinus pinea*) are sometimes called. The first three—gooseberries, currants, and raspberries, thrive best in the colder districts. Walnuts and almonds should be planted extensively only in the dry localities; and all may be planted out at any time during the planting season except loganberries, passion vines, Cape gooseberries, and tree tomatoes, which are usually planted in the spring-time. Shelter is a feature which demands careful consideration where large plantations of bush fruits are grown: adequate shelter is a necessity and nothing is better than well-grown hedges and plantations.

During the first season some inter-cropping with vegetables may be done, so long as first consideration is given to the welfare of the permanent crops.

The Homestead Garden.

Where new gardens are being made the preparation of the land for setting out plantations, shrubberies, and herbaceous borders is now being done. For large plantations on flat land it is a great advantage if the grassland is well broken in by skimming and double ploughing before the trees are planted. For shrubberies and herbaceous borders the ground is trenched, and, for the latter especially, a generous dressing of farm manure is worked in. If this work is done thoroughly and all bad perennial weeds are quite eradicated there will be no doubt about obtaining good results if a suitable selection of trees and shrubs is planted and they are arranged effectively. The last two points require much time and study, but the comparatively permanent nature of the work makes it advisable to give it every consideration.

In established gardens it is well to remember that spring flowering bulbs should be planted now: they are planted at any time during the first four months of the new year, but the earlier the better, so that they may be well rooted before any top growth is made.

There are few established gardens that cannot be improved by a little rearrangement and addition to the shrubberies and isolated specimen trees. Many subjects such as tree ferns, palms, and clematis cannot be planted satisfactorily until adequate shade and shelter is established. The planting season affords the necessary opportunity for carrying out these alterations, and in the meantime the necessary consideration may be given to the work so that it may be done to best advantage. Plants that have been unsuitably placed can often be removed and planted where they will give better service, while successful planting can often be supplemented to give a greatly improved appearance. Hydrangeas in rather shaded positions have done well this season, and maintained a display of bloom when the rhododendrons had finished. In turn they are being succeeded by that Japanese lily known as *Lilium speciosum*, red and white, which delights in such an association under those conditions.

—W. C. Hyde, Horticulturist, Wellington.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

PAINT FOR FARM BUILDINGS AND EQUIPMENT.

W. T. B., Papakura :—

As paint for farm buildings (wood with iron roofs), farm-gates, &c., would powder red oxide mixed with boiled linseed oil serve suitably? If so, what amounts of materials should be used?

The Public Works Department :—

Powder red oxide, mixed with boiled linseed oil, would answer the purpose; and if you decide to use this, the proportions are easy to remember. For each pound of oil use 1 lb. of powder red oxide, but it would be advisable to use sufficient oil with the red oxide to form a paste; and after thoroughly mixing leave it for a month before adding the balance of the oil. It is considered preferable to use red oxide ground in oil to mix with linseed oil, as you will get a superior product from machine mixing to that done by hand. This is a matter entirely for your decision, but the following figures may help you to decide: Linseed-oil 5 gallons, weight 47 lb., costing approximately 4s. 6d. per gallon, equals £1 2s. 6d.; powder red oxide 47 lb., costing 3d. per pound, 11s. 9d.: total, £1 14s. 3d. This would give, approximately, 5⅞ gallons of paint, costing about 5s. 10d. per gallon. Linseed-oil 2½ gallons, weight 23½ lb., costing approximately 4s. 6d. per gallon, equals 11s. 3d.; 72 lb. of red oxide in oil, costing approximately 5d. per pound, equals £1 10s.: total, £2 1s. 3d. This would give you 6½ gallons of paint, costing approximately 6s. 4d. per gallon. Paints suitable for this class of work are also put up by paint-manufacturers, and if your requirements are small, this is the most satisfactory way to buy, providing you purchase goods made by a reputable firm. It would be wise to check up the local costs of articles mentioned before reaching a decision.

METHOD OF KILLING TREES.

R. T. C., Hinakura, Martinborough :—

I seek an effective way to kill the ordinary blue-gum trees which were cut down last winter to a few feet off the ground. They are now making growth again profusely. I bored into the centre with a 2 in. auger and poured salt in, and also a solution containing arsenic, but without success.

The Horticulture Division :—

The attempt to kill the blue-gum tree was unsuccessful probably because the liquid agent was placed in the centre of the stump. The vital formative tissue is just beneath the bark of the tree, and the arsenic solution, or whatever may be used, should be placed in the sap wood so that it may readily act upon that tissue to destroy it.

PROVISION OF NESTS FOR HENS.

Novice, Tinwald :—

How many nests are required for 100 hens, each nest to be large enough to take two hens at the same time?

The Live-stock Division :—

From twelve to fifteen nest-boxes sufficiently large to accommodate two hens in each would be sufficient for 100 hens.

WEATHER RECORDS: JANUARY, 1935.

Dominion Meteorological Office.

NOTES FOR JANUARY.

THE present summer bids fair to be the hottest every experienced in the Dominion. Though not quite so much above normal as December, mean temperatures in January were very high. Rainfall was again much below average over a large part of the country, and, though many drier Januarys have been experienced, the continued rain-shortage, combined with the very high temperatures, has resulted in serious conditions for the farmer in most of the more thickly settled districts. Pastures are, in general, burnt up, and in many places there is a shortage of water. The milk yield has fallen off very greatly, and stock are beginning to lose condition. Cereal crops will be light and the grain in many cases shrivelled. Many of the crops were late-sown, and the dry weather has been more severe on them than would otherwise have been the case. The prospects for fodder crops are not good. Insect pests are rather troublesome in some districts. Nelson, Westland, parts of Otago and Southland, and some of the high country of the North Island, are in much better condition than the rest of the Dominion, but for the country as a whole the position is a serious one and rain is very badly needed.

Rainfall.—Heavy rains were recorded in the western half of the South Island. Parts of eastern Otago and south Canterbury and of the high country in Taranaki and Wellington also fared well. Elsewhere the month was a very dry one. The position is most acute in the Waikato, Bay of Plenty, and east coast districts of the North Island and most of Canterbury and Marlborough.

Temperatures were everywhere considerably above the normal. In some parts, January, 1887, was hotter, but for the Dominion as a whole last month was probably the hottest January hitherto experienced. In the North Island the departures from average were everywhere large, but in the South conditions were less uniform. There were not many high-temperature records broken, but it was almost continuously warm, and many readings above 90 degrees were registered.

Sunshine.—South of Nelson and Marlborough the amount of sunshine recorded did not, as a rule, differ greatly from the average for January, but elsewhere the month was a very sunny one. Tauranga reports 327·6 hours, Blenheim 299·1, and Napier 293·9.

Storm Systems.—Typical summer weather conditions prevailed throughout the month. Numerous depressions travelled across the Tasman Sea and New Zealand, but generally they were quickly moving, shallow, and of complicated form. As in the previous two months, they were much less vigorous over New Zealand than over Australia, and none of them produced a really good general rain. Again, also, there was an absence of strong outbreaks of cold air from the south, although Australia experienced a number. Disturbed weather prevailed, also, in the Pacific Island group. There was a considerable amount of westerly wind, especially over the South Island, and consequently frequent heavy rains occured on the west coast and in the ranges of the South Island. Some of these extended to the high country in Wellington and Taranaki. Such rains occurred from the 7th to 9th, on the 25th and 26th, and on the 28th and 29th.

Between the 1st and 3rd, two depressions following closely on one another brought widespread rains, with heavy falls in many places. This was the wettest period of the month.

Again, between the 17th and the 22nd, a depression which, though shallow, was of a shape more favourable for rain than most of the remainder, and which was followed by a fairly strong southerly, was responsible for almost general falls. Unfortunately, however, they were in many cases only light.

Rainfalls for January, 1935, at Representative Stations.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
	North Island.					
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	1·80	6	1·08	3·94	1·80	3·94
Russell	1·80	8	0·64	3·25	1·80	3·25
Whangarei	3·93	9	2·91	3·93	3·93	3·93
Auckland	2·24	6	1·74	2·72	2·24	2·72
Hamilton	1·20	7	0·38	3·57	1·20	3·57
Rotorua	1·84	6	0·91	4·26	1·84	4·26
Kawhia	1·84	6	0·82	3·55	1·84	3·55
New Plymouth ..	4·61	11	1·70	4·19	4·61	4·19
Riversdale, Inglewood ..	8·56	14	3·21	7·51	8·56	7·51
Whangamomona ..	11·71	9	4·11	5·58	11·71	5·58
Hawera	2·24	10	0·51	3·51	2·24	3·51
Tairua	1·39	3	0·73	3·66	1·39	3·66
Tauranga	0·96	7	0·63	4·08	0·96	4·08
Maraehako Station, Opotiki	2·75	5	1·16	3·59	2·75	3·59
Gisborne	1·12	5	0·70	2·72	1·12	2·72
Taupo	1·38	7	0·44	3·37	1·38	3·37
Napier	0·41	6	0·11	2·93	0·41	2·93
Hastings	0·48	6	0·19	1·93	0·48	1·93
Whakarara Station ..	1·57	7	0·86	..	1·57	..
Taihape	2·66	9	0·72	3·20	2·66	3·20
Masterton	0·80	6	0·52	2·60	0·80	2·60
Patea	2·54	10	0·92	3·59	2·54	3·59
Wanganui	2·67	5	1·39	2·83	2·67	2·83
Foxton	1·70	9	0·70	2·14	1·70	2·14
Wellington	1·87	9	0·66	2·81	1·87	2·81
	South Island.					
Westport	11·57	20	2·03	8·20	11·57	8·20
Greymouth	14·35	21	2·66	9·17	14·36	9·17
Hokitika	16·49	22	3·73	10·07	16·49	10·07
Ross	15·21	17	2·58	12·40	15·21	12·40
Arthur's Pass ..	20·30	19	4·30	14·12	20·30	14·12
Okuru, South Westland	22·45	12	5·00	12·59	22·45	12·59
Collingwood	6·05	12	1·67	6·71	6·05	6·71
Nelson	3·27	9	1·18	2·81	3·27	2·81
Spring Creek, Blenheim	1·13	9	0·25	2·22	1·13	2·22
Seddon	1·25	6	0·45	1·84	1·25	1·84
Hanmer Springs ..	2·04	11	0·48	3·90	2·04	3·90
Highfield, Waiau ..	0·79	8	0·22	2·98	0·79	2·98
Gore Bay	..	..	..	2·46	..	2·46
Christchurch	0·77	10	0·38	2·18	0·77	2·18
Timaru	2·31	11	0·70	2·27	2·31	2·27
Lambrook Station, Fairlie	..	..	..	2·43	..	2·43
Benmore Station, Clearburn	1·88	14	0·53	2·77	1·88	2·77
Oamaru	1·53	15	0·60	2·04	1·53	2·04
Queenstown	4·35	15	0·86	2·92	4·35	2·92
Clyde	1·94	12	0·77	1·85	1·94	1·85
Dunedin	3·04	15	0·83	3·43	3·04	3·43
Wendon	4·23	16	0·80	3·20	4·23	3·20
Balclutha	4·04	15	0·75	2·31	4·04	2·31
Invercargill	7·19	20	1·05	4·01	7·19	4·01
Puysegur Point ..	14·89	23	2·10	7·62	14·89	7·62
Half-moon Bay ..	8·09	21	1·27	4·82	8·09	4·82